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May 9, 2006

U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, Kansas 66101

ATTENTION: Mr. Dan Wall

SUBJECT: Feasibility Study Report
West Lake Landfill Operable Unit 1, Bridgeton, Missouri

Dear Mr. Wall,

On behalf of Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton), Inc., Rock Road Industries, Inc., and the United Sates Department of Energy (the "Respondents"), Engineering Management Support Inc. (EMSI) submits the attached Feasibility Study report for Operable Unit-1 at the West Lake Landfill Superfund Site. If you have any questions or desire additional information related to this report or any other aspect of the project, please do not hesitate to contact me.

Sincerely,
ENGINEERING MANAGEMENT SUPPORT, Inc.

Paul V. Rosasco, P.E.

Distribution:

Shawn Muenks – Missouri Department of Natural Resources
Victoria Warren - Allied Waste Industries, Inc.
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Feasibility Study

West Lake Landfill
Operable Unit 1

Prepared for:

West Lake Landfill OU-1 Respondents Group

Prepared by:

Engineering Management Support, Inc.
8125 West Grand Avenue, Suite 100
Littleton, Colorado 80123

May 8, 2006

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1 INTRODUCTION

Engineering Management Support Inc. (EMSI) has prepared this Feasibility Study (FS) for Operable Unit (OU) -1 at the West Lake Landfill located in Bridgeton, Missouri on behalf of Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC (formerly known as Laidlaw Waste Systems [Bridgeton], Inc.), Rock Road Industries, Inc., and the United Sates Department of Energy (the "Respondents"), Respondents to an Administrative Order on Consent (AOC) [CERCLA Docket No. VII-93-F-005] with the United States Environmental Protection Agency (USEPA) to conduct a remedial investigation and feasibility study (RI/FS) at the West Lake Landfill site, OU-1. OU-1 includes conditions associated with two areas of radiological impacted materials, Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2), at the West Lake Landfill. Investigation and evaluation of the occurrences of non-radioactive constituents in other parts of the landfill are being performed by Bridgeton Landfill, LLC under a separate operable unit (OU-2) RI/FS.

1.1 Purpose, Objectives and Scope of the FS

The purpose of an FS is to evaluate potential remedial options consistent with the procedures set forth in the National Contingency Plan (NCP) as further described in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988a); guidance for "Conducting Remedial Investigation/ Feasibility Studies for CERCLA Municipal Landfill Sites" (USEPA, 1991); and guidance for "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b). The primary objectives of an FS are to develop an appropriate range of waste management options that ensure the protection of human health and the environment and to assess each alternative in terms of the evaluation criteria prescribed by the NCP.

This FS for OU-1 at the West Lake Landfill has been prepared in accordance with the requirements of the AOC. Specifically, this report addresses the requirements of Sections 6.0 (Task V – Development and Screening of Remedial Alternatives) and 7.0 (Task VI – Detailed Analysis of Remedial Alternatives) of the Remedial Investigation/Feasibility Study (RI/FS) Statement of Work (SOW) to the AOC. The requirements of Sections 6.0 and 7.0 of the SOW were subsequently modified as set forth in letters from Mr. Paul Rosasco of EMSI to Mr. Steven Kinser of USEPA Region VII dated March 11, 1997 and May 16, 1997, and EPA's letter of April 7, 1997. Revision to the OU-1 FS requirements were also made consistent with EPA Region VII's determination that EPA's guidance on "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b) should be considered for use in developing the FS for the West Lake Landfill. Use of the presumptive remedy approach for municipal landfill sites is discussed further in Section 4.4.2 of this report.

Based on EPA guidance and EPA Region VII decisions regarding the change in approach to completion of the FS, the requirements in Sections 6.0 and 7.0 of the SOW for a technical memorandum on Refined Remedial Action Objectives, a report on the Development and Screening of Remedial Alternatives, and a technical memorandum on the Comparison of Alternatives, along with the requirement for an initial screening of alternatives were deleted. Instead, the RAOs, the development and screening of alternatives and the comparison of alternatives are presented in this FS report. These revisions to the OU-1 FS requirements were developed to reflect EPA's presumptive remedy approach to CERCLA municipal landfill sites and in order to reduce the overall project schedule.

1.2 Feasibility Study Process Overview

According to the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988a), development of the FS should generally follow a prescribed methodology. Once a site has been adequately characterized through the RI process and risks to human health and the environment have been assessed through preparation of a baseline risk assessment (BRA), the FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions to address issues and risks identified in the RI and BRA. The FS process typically occurs in three phases: the development of remedial alternatives, screening of the alternatives, and the detailed analysis of alternatives.

Alternatives for remedial action are developed by assembling combinations of technologies, and the media to which they would be applied, into alternatives that address contamination on a site-wide basis or for an identified OU. The alternatives development process consists of several general steps, which are briefly discussed as follows:

- Develop remedial action objectives (RAOs) specifying the contaminants, media of interest, and exposure pathways that permit a range of containment and treatment alternatives to be developed. The RAOs are developed based on chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and site-specific risk-related factors.

- Develop general response actions (GRAs) for each medium of interest such as institutional controls, containment, or other actions, singly or in combination that may be taken to satisfy the RAOs for the site or OU.

- Identify volumes or areas of media to which GRAs might be applied, taking into account the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the site.

- Identify and screen the technologies applicable to each GRA to eliminate those that cannot be implemented technically at the site or OU (Note: This initial

screening step is a medium-specific technology screening step conducted during development of alternatives, as opposed to the alternative screening step that is conducted subsequently to reduce the number of alternatives prior to the detailed analysis of alternatives). The GRAs are further defined to specify remedial technology types (e.g., the GRA of treatment can be further defined to include physical, chemical, or biological technology types).

- Evaluate technology process options to select a representative process for each technology type retained for consideration. Although specific processes are selected for alternative development and evaluation, these processes are intended to represent the broader range of process options within a general technology type.

- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations, as appropriate.

At many sites, a large number of alternatives are typically identified based on the results of the technology screening. In order to reduce the number of alternatives that are subjected to detailed evaluation and to focus the evaluation of alternatives, the list of alternatives developed based on the technology screening is often subjected to an initial screening based on the anticipated effectiveness, implementability and cost of the alternatives. As previously discussed, EPA Region VII previously agreed that the alternative screening step was not necessary for completion of the West Lake OU-1 FS, consistent with EPA's guidance on "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b).

The potential remedial alternatives are then subjected to a detailed analysis using the nine criteria specified in the NCP. After completion of the detailed analysis of alternatives, the alternatives are subjected to a comparative analysis again using the nine criteria specified in the NCP.

1.3 Coordination with OU-2

OU-1 includes two separate sub areas within the overall area of the West Lake Landfill. These two areas, referred to as Area 1 and Area 2 contain radiologically impacted soil. The impacted soil is interspersed with and contained within an overall matrix of solid waste materials. Both Area 1 and 2 are part of larger areas of previously placed solid wastes which in turn are located within a 230 acre solid waste landfill and industrial use complex.

The radiologically impacted portions of Areas 1 and 2 represent only a portion of these areas, which in turn only represent a portion of the overall landfill area. Consequently, possible remedial actions for the radiologically impacted materials in Areas 1 and 2 cannot be implemented without consideration of ongoing activities at the landfill and

possible future landfill operations, closure activities or remedial actions that may be implemented for other portions of the landfill. Evaluation of the need for and possible scope of potential remedial actions for other portions of the landfill are being evaluated as part of a separate operable unit, OU-2.

Selection and implementation of a remedy for OU-1 will necessarily involve coordination with the remedial action, if any, to be selected for OU-2. Such coordination may include but is not necessarily limited to issues related to the scope of the remedial actions for each OU, timing of implementation of potential remedy components, the compatibility of the remedial actions that may be selected for each OU, and the overall protectiveness of the combined remedial actions. Of particular interest will be coordination of any grading, landfill cover or drainage improvements that may be implemented for either of the OUs.

This FS only addresses the development and evaluation of potential remedial alternatives for OU-1. Where possible coordination issues may exist with remedial actions that may be implemented for OU-2, these issues are identified as part of the various alternative evaluations presented in this report.

As discussed later in this FS report, the remedy for OU-1 is likely to be focused on implementation of an upgraded landfill cover over the OU-1 area. The potential landfill cover improvements (grading, cover design, etc.) presented later in this FS report were developed with consideration of the configuration of the landfill areas outside of and adjacent to the OU-1 areas. Consequently, no technical compatibility issues are anticipated with implementation of any of cover designs presented later in this FS report. Implementation of these cover designs is also unlikely to limit options for OU-2.

1.4 Report Organization

Section 2 of the FS summarizes the surface and subsurface conditions at the Site, the nature and extent of contamination and potential risks associated with such contamination based on the results of the RI and BRA evaluations. Section 3 includes a preliminary identification of potential ARARs and development of RAOs. The identification of GRAs, identification and initial screening of technologies, evaluation of technologies and process options, and development into potential remedial alternatives are presented in Section 4. The potential remedial alternatives developed in Section 4 are then analyzed in detail in Section 5. Section 6 presents a summary comparison of the alternatives. A list of references is included in Section 7 of this report.

Appendix A contains copies of EPA's various guidance documents related to use of the presumptive remedy approach for CERCLA municipal landfill sites. Appendix B contains a detailed evaluation of potential "hot spots" and possible "hot spot" removal performed in accordance with EPA guidance (EPA, 1993b). The results of this evaluation are also summarized in Section 4.4.3 of this report. Appendix C contains copies of the existing land use covenants that have been implemented for the West Lake

Landfill and Radiological Areas 1 and 2. Detailed information regarding the estimated costs presented in Section 5 of the FS is contained in Appendix D.

2 SITE CONDITIONS

This section presents a summary of the surface and subsurface conditions at the West Lake Landfill based on the results of the RI evaluations (EMSI, 2000). This section also presents a conceptual model of the occurrence of radiologically impacted materials and the potential pathways through which radionuclides have or could migrate from Areas 1 and 2. A summary of the potential risks posed by both the radionuclides and the non-radiological parameters present in, and potentially migrating from, Areas 1 and 2 is also provided in this section.

2.1 Summary of Site Conditions

Surface and subsurface conditions at the West Lake Landfill, in particular as they relate to Radiological Areas 1 and 2 of OU-1, are summarized in this section.

2.1.1 Surface Conditions

The West Lake Landfill is situated on the eastern edge of the Missouri River floodplain approximately two miles east of the river (Figure 2-1), at the western edge of the City of Bridgeton. Immediately west, between the City of Bridgeton and the Missouri River is a primarily industrial area of unincorporated St. Louis County known as Earth City. The river is separated from Earth City by a levee system. The topography of the West Lake Landfill area has been significantly altered by quarry activities in the eastern portion of the landfill, and by placement of mine spoils and landfill materials in the eastern and western portion of the landfill.

Area 1 is situated on the north and western slopes of a topographic high within the landfill. Ground surface elevation in Area 1 varies from 490 feet on the south to 452 feet at the roadway near the landfill property entrance.

Area 2 is situated between a topographic high of landfilled materials on the south and east and the Buffer Zone and Crossroad properties (former Ford property) on the west. The highest topographic level in Area 2 is about 500 feet on the southwest side of Area 2 sloping to approximately 470 feet near the top of the landfill berm along the south side of the Ford property. The upper surface of the berm along the western edge of Area 2 is located approximately 20 to 30 feet above the adjacent Ford property and approximately 30 to 40 feet higher than the water surface in the flood control channel located to the southeast of Area 2. A berm on the northern portions of Area 2 controls runoff to the adjacent properties.

On the north side of Area 2 is the property referred to in the RI as the Ford Property. This property was previously owned by Ford Motor Credit, Inc. Prior to 1998, Ford

subdivided and sold all of its property in this area. The majority of the Ford property was sold to Crossroad Properties LLC and has been developed into the Crossroad Industrial Park. Crossroad has developed all of their property with the exception of Lot 2A2, a 3.58 acre parcel located immediately north of the Buffer Zone. Ford retained the 1.78 acres immediately adjacent to the western portion of the northern boundary of Area 2, referred to as the Buffer Zone, the ownership of which was subsequently acquired by Rock Road Industries, Inc. (Rock Road) on behalf of the Respondents.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 29189C0039 H (FEMA, 1995) indicates that Areas 2 and the northern portion of Area 1 are in the Zone X flood area (Figure 2-2). The Zone X flood area includes areas of the 500-year floodplain, areas of 100-year flood with average depths of less than 1 foot or within drainage areas less than 1 square mile, or areas protected by levees from the 100-year flood. The map reflects the fact that at one time the surface elevation of Areas 1 and 2 were below the 100 year high water levels. Landfilling in this area has significantly raised the elevation of Areas 1 and 2 above the level of the floodplain. Specifically, according to FEMA's FIRM for this area, in the event of a 100 year flood, the water elevation would rise to between 453 to 454 feet within the levee system along the river (FIRM, St. Louis County, Panels 38 and 39, effective date August 2, 1995). The surface of the Area 2 berm is approximately 20 feet above the projected 100-year flood elevations within the levee system along the river. Flooding of areas adjacent to the landfill (i.e., areas outside of the levee system) would only occur as a result of a failure of the levee system. Spreading of floodwaters into areas outside of the levee system would result in lower flood elevations than those projected to occur within the levee system. Therefore, the actual elevations of any floodwaters that may extend into areas adjacent to the landfill are expected to be less than 453 feet. No flooding of the landfill or the adjacent Crossroad property was observed in 1993 and 1995 during the 500- and 300-year flood events that occurred in these years.

Surface runoff from Area 1 ultimately flows north to a drainage ditch along the south side of the landfill access road, east to the drainage ditch on the southwest side of St. Charles Rock Road and then north to a small pond located just north of the northwest corner of Area 2 (Figure 2-3). Runoff from Area 2 generally flows into an internal closed topographic depression within Area 2 (Figure 2-3). Some of the southern part of Area 2 drains into on-site drainage ditches that eventually route runoff to the drainage along the landfill access road and then to the drainage and pond along St. Charles Rock Road. During major storm events, a very small portion of Area 2 can potentially drain down the landfill berm onto the Ford property.

Three types of plant communities were identified in Areas 1 and 2. These include old field and hydrophilic plant communities identified in both Areas 1 and 2 and a forest plant community identified in Area 2 only. A fourth plant community, a maintained field community, was identified in areas adjacent to the landfill. The maintained field areas are subjected to mowing at frequency of at least once per year. No sensitive species or communities are known to occur on the landfill or in the surrounding area.

The West Lake Landfill is located in a predominantly industrial area. The entire landfill area, including the areas investigated under OU-1 and OU-2, has been the site of historic quarry operations to remove limestone, and historic and active landfill operations. The southernmost portion of the West Lake Landfill is permitted for active sanitary landfill operations (Permit No. 118912). Other activities conducted on the OU-2 portion of the property include concrete and asphalt batch plant operations and an auto repair facility (Figure 2-4).

The southern portion of the West Lake Landfill is zoned M-1 (manufacturing district, limited). Although the northern portion of the West Lake Landfill is zoned R-1 (one family dwelling district), this area has never been used for residential purposes, is bounded on all sides by industrial and commercial uses, and has been used for industrial purposes for more than fifty years. Moreover, the Missouri Court of Appeals affirmed in a trial court's finding that the "residential" zoning of the West Lake Quarry property directly south of the West Lake Landfill was unconstitutional, unreasonable and arbitrary. *West Lake Quarry and Material Company v. City of Bridgeton, 761 S.W. 2d 749 (Mo App 1988)*. The court specifically considered commercial-industrial land uses of the surrounding property, the high development costs for residential, noise from airplanes, and other evidence and concluded that property in this area is "totally inappropriate for residential development" and ordered the City to rezone the property M-2 (commercial-industrial) [*Id. at 752*]. Even though a portion of the Site is zoned residential, as a practical matter, the only reasonable future use of the Site is commercial-industrial, not residential.

Residential land use and groundwater use have been prohibited at the West Lake Landfill by restrictive covenants recorded by each of the property owners against their respective parcels. The covenant restrictions cannot be terminated without the written approval of the future owners, Missouri Department of Natural Resources (MDNR), and USEPA. Additional land use covenants have been recorded against Areas 1 and 2 to prevent construction of buildings or utility excavations in these areas.

Land use in the area surrounding the landfill is commercial and industrial. The property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City industrial park is located adjacent to the landfill on the south and west, across Old St. Charles Rock Road. The nearest residential development, "Spanish Village", is located to the south of the landfill near the intersection of St. Charles Rock Road and I-270 approximately ¾ mile from Area 1 and 1 mile from Area 2. Mixed commercial, retail, manufacturing and single family residential uses are present to the southeast of the landfill. The land use zoning for the West Lake Landfill and surrounding area is shown on Figure 2-5.

2.1.2 Subsurface Conditions

The geology of the landfill area consists of Paleozoic age sedimentary rocks overlying Pre-Cambrian age igneous and metamorphic rocks. The Paleozoic bedrock is overlain by unconsolidated alluvial and loess deposits of recent (Holocene) age.

The uppermost bedrock units near the landfill consist of Mississippian age limestone and dolomite with inter-bedded shale and siltstone layers of the Kinderhookian, Osagean, and Meramecian Series. The Kinderhookian Series is an undifferentiated limestone, dolomitic limestone, shale and siltstone unit ranging in thickness from 0 to 122 feet in the St. Louis area. The Osagean Series consists of the Fern Glen Formation, a red limestone and shale, and the Burlington-Keokuk Formation, a cherty limestone. The Fern Glen Formation ranges in thickness from 0 to 105 feet and the Burlington-Keokuk Formation ranges from 0 to 240 feet thick in the St. Louis Area.

The Meramecian Series overlies the Osagean Series rocks. The Meramecian Series consists of several formations including the Warsaw Formation, the Salem Formation, the St. Louis Formation, and the St. Genevieve Formation. The St. Genevieve Formation is reportedly not present near the landfill (Golder, 1996).

Pennsylvanian-age Missourian, Desmoisian, and Atokan formations are present in some areas above the Mississippian-age rocks. The Pennsylvanian-age rocks consist primarily of shale, siltstone, and sandstone with silt and clay. These formations range in combined thickness from 0 to 375 feet in this area. The Atokan-Series Cheltenham Formation was identified as being present in the former landfill soil borrow area located to the southeast of the landfill.

Groundwater is present in both the bedrock units and the unconsolidated materials. The major bedrock aquifers of the St. Louis area include the Cambrian-age Potosi Dolomite and the Ordovician-age Gasconade Dolomite, Roubidoux Formation and St. Peter Sandstone.

Alluvial deposits of varying thickness are present beneath Areas 1 and 2. The landfill debris varies in thickness from 5 to 56 feet in Areas 1 and 2, with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The underlying alluvium increases in thickness from east to west beneath Area 1. The alluvial thickness beneath the southeastern portion of Area 1 is less than 5 feet (bottom elevation of 420 feet above mean sea level [AMSL]) while the thickness along the northwestern edge of Area 1 is approximately 80 feet (bottom elevation of 370 feet AMSL). The thickness of the alluvial deposits beneath Area 2 is fairly uniform at approximately 100 feet (bottom elevation of 335 feet AMSL).

During the RI investigations, groundwater was generally encountered in the underlying alluvium near or immediately below the base of the landfill debris. Isolated bodies of

perched water were encountered in two of the 24 soil borings drilled in Area 1 and six of the 40 soil borings drilled in Area 2 as part of the RI field investigations. The perched water generally occurs in small isolated units at depths varying from five to 30 feet below ground surface.

Monthly groundwater levels measured in various landfill wells indicate that groundwater generally occurs only in the underlying alluvium at or below the base of the landfill materials with the exception of the localized perched water conditions encountered in isolated areas within the landfill. Groundwater elevations varied seasonally and were generally lowest during the fall and winter months (September through March) and highest during the spring and summer months (April through August).

The RI data indicate that only a very small amount of relief (less than one foot) exists in the water table surface beneath the landfill. Based on the water level data, the inferred direction of groundwater flow beneath Area 1 is to the south toward the active landfill. Water level elevations beneath Area 2 displayed areal differences of less than one foot making a site-specific determination of the direction of the hydraulic gradient impossible. The regional direction of groundwater flow is in a generally northerly direction within the Missouri River alluvial valley, parallel, or sub-parallel to the river alignment.

No public water supply wells that obtain water from the alluvial aquifer are present near the landfill. An inventory of private wells in the area of the landfill is presented in the RI report (EMSI, 2000). The results of this inventory indicated that the nearest private well reportedly used as a drinking water source is located one mile to the north of the landfill (Foth & Van Dyke, 1989). This well is the nearest downgradient well that may be used for drinking water purposes. Two additional wells that are not used for drinking water purposes are also located 5,100 ft to the northwest and 4,600 ft to north-northeast of the landfill (EMSI, 2000).

An updated well inventory was prepared as part of the RI for OU-2 (Herst & Associates, 2005). This evaluation included an inventory of both registered and unregistered wells located within approximately five miles of the West Lake Landfill. The closest registered well is located approximately one mile northeast of the landfill. This well was reportedly drilled to a depth of 245 ft which indicates a bedrock completion. Regional groundwater flow in the vicinity of the landfill is to the northwest, towards the Missouri River. Accordingly, the nearest registered well is not downgradient of the landfill. The closest registered well that appears to be completed in alluvium is approximately 2.5 miles south (upgradient) of the landfill.

Fifteen unregistered wells were reported to exist within five miles of the West Lake Landfill (Herst & Associates, 2005). Field reconnaissance was performed to verify the reported locations of the unregistered wells. Based on the field reconnaissance, only one of the fifteen reported unregistered wells was verified as present and the resident at this location stated that the well is no longer used because the property is serviced by municipal water.

2.2 Nature and Extent of Contamination

This section of the FS summarizes occurrences of radiological and non-radiological constituents detected in the soil borings completed in Areas 1 and 2.

2.2.1 Radiologically Impacted Materials

Radionuclides are present in a dispersed manner throughout the landfill deposits in Area 1 and Area 2. Radiological constituents occur in soil materials that are intermixed with and interspersed in the overall matrix of landfilled refuse, debris and fill materials and unimpacted soil. In some portions of Areas 1 and 2, radiologically impacted materials are present in the upper six inches; however, the majority of the radiological occurrences are present in the subsurface beneath these two areas.

In general, the primary radionuclides detected at levels above background concentrations at the West Lake Landfill are part of the uranium-238 and uranium-235 decay series. Thorium-232 and radium-224 isotopes from the thorium-232 decay series were also present above background levels but at a lesser frequency.

The discussions regarding the locations and extent of the radiologically impacted materials presented in the RI and summarized below were based in part on the concept of "reference levels". Reference levels were derived in the RI report based upon the EPA "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings" as set forth in Title 40, Part 192, Sections 12 and 41. These standards state that:

> The concentration of radium-226 (or radium-228) in land averaged over any area of 100 square meters shall not exceed the background level by more than - (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

These standards are only applicable to uranium and thorium mill tailings sites designated under the Uranium Mill Tailings Radiation Control Act (UMTRCA). At the time the RI was prepared, no other numerical standards had been identified that could assist in characterizing the potential extent of the radiologically impacted materials at the West Lake Landfill. In the absence of any other established standards, values based upon the standards promulgated by EPA under 40 CFR 192 were included in the RI evaluations solely as a point of reference and as a means of easily and consistently identifying the radiologically impacted materials and assessing their extent. In referencing these standards, however, the RI states that risk-based levels that are considered to be protective of human health and the environment from radionuclide occurrences at the landfill would be based upon the results of the BRA, and that use of reference levels in the RI should not be construed as representing selection of the 40 CFR 192 standards as ARARs or selection of these standards as actual or potential remediation standards.

2.2.1.1 Radiological Area 1

Radionuclides are present in the upper 6 inches (15 cm) at levels above UMTRCA standard for surface soil (5 pCi/g over background) over approximately 50,700 square feet (1.16 acres) of Area 1 (Figure 2-6). Approximately 194,000 square feet (4.45 acres) of Area 1 have radionuclides present in the subsurface at depths ranging up to 7 feet, with localized intervals present to depths of 15 feet (Figure 2-7). Subsurface occurrences of radionuclides in Area 1 are present in soil material that is intermixed with the overall landfill matrix of refuse, debris and fill materials. The total volume of radiologically impacted materials and associated landfill materials in Area 1 is estimated to be approximately 24,400 cubic yards (EMSI, 2000).

2.2.1.2 Radiological Area 2

Radionuclides are present in the upper 6-inches (15 cm) over approximately 468,700 square feet (10.76 acres) of Area 2 (Figure 2-6). An additional 17,200 square feet in the northeastern portion of Area 2 contains soil/sediment eroded from the surface of Area 2. Radionuclide impacted materials are present in the subsurface beneath approximately 817,000 square feet (18.76 acres) of Area 2 at depths of up to approximately 12 feet, with some localized deeper intervals (Figure 2-7). Subsurface occurrences of radionuclides in Area 2 are present in soil material that is intermixed with the overall landfill matrix of refuse, debris, fill and non-impacted soil materials. The total volume of radiologically impacted materials and associated landfill materials in Area 2 is estimated to be approximately 118,000 cubic yards.

2.2.1.3 Radiological Occurrences on the Ford and Crossroad Properties

During the RI (EMSI, 2000), an additional 196,000 square feet of impacted surface materials were identified in the southern portion of what at that time was property owned by Ford Motor Credit (referred to as the Ford property) located immediately west of Area 2 (Figure 2-8). A portion of the Ford property was subsequently sold to Crossroad Properties, LLC (Crossroad) and a portion was retained by Ford (the buffer property). Reportedly, subsequent to completion of landfilling activities in Area 2, erosion of soil from the landfill berm occurred resulting in transport of radiologically impacted materials from Area 2 onto the adjacent Ford (now Buffer Zone and Crossroad) property (EMSI, 2000). The area has subsequently been revegetated by natural processes and no evidence of subsequent erosion or other failures have been identified. Occurrences of radionuclides were found in surficial (6 to 12 inches or less) soil at the toe and immediately adjacent to the landfill berm as a result of the historic erosion from Area 2.

Based on an areal extent of 196,000 square feet and a presumed 6-inch thickness, the volume of radiologically impacted materials located on the Ford property was estimated to be 3,600 cubic yards.

In November 1999, the vegetation and surface soil were scraped from the buffer property and a portion of the adjacent Crossroad property to a depth of approximately 2 to 6 inches. These activities were unauthorized and reportedly conducted by AAA Trailer, a neighboring property owner. The removed materials were piled in a berm along the southern boundary of the buffer property, adjacent to the northwestern boundary of the West Lake Landfill. A small amount of removed materials was also placed in a small pile on the Crossroad property.

EMSI prepared an Interim Measures Work Plan (EMSI, 1999) to address consolidation and stabilization of the soil piles and additional surface soil sampling. In February 2000, Herst & Associates at the request of EMSI on behalf of the Respondents collected additional surface soil samples from the disturbed area for laboratory testing. Only one sample (RC-02) obtained below and adjacent to the area of the former slope failure contained radionuclides (specifically thorium-230) above reference levels. The remainder of the samples contained either background levels of radionuclides or levels above background but below the reference levels.

The results of the additional soil sampling conducted in 2000 indicated that most of the radiologically impacted soil that had previously been present on the Buffer Zone and Lot 2A2 of the Crossroad property had been removed and was now located in the stockpiles. Evaluation of the soil sampling results obtained prior to and after the 1999 disturbance indicates that approximately one acre of the Buffer Zone may still contain some radionuclides above reference levels.

Inspection of the area in May 2000 indicated that native vegetation had been re-established over both the disturbed area and the stockpiled materials. The presence of native vegetation over these materials was determined to be sufficient to prevent windblown or rainwater runoff of these materials. Consequently, no additional interim measures were implemented.

A recent inspection of this area indicated that additional soil removal/regrading has been performed on the remaining portion of the Crossroad property and the adjacent Buffer Zone property by, or on the behalf of, AAA Trailer. These activities appear to have resulted in removal of the soil piles created during the previous regrading activity conducted by AAA Trailer, removal of the remaining soil on Lot 2A2 and the Buffer Zone that had not been excavated by AAA Trailer during the 1999 regrading it performed in this area, and placement of gravel over Lot 2A2 and the Buffer Zone. According to AAA Trailer, all of the soil removed during the July 1999 grading work and the May 2003 gravel layer installation, was placed in the northeastern corner of the Buffer Zone (terra technologies, 2004). Trailers associated with AAA Trailer's operations have been parked in this area although use of the Buffer Zone, which is owned by the Respondents,

for this purpose, has not been authorized. As sampling has not been performed after the most recent grading work conducted by AAA Trailer (May 2003), the levels and extent of radionuclides, if any, that may remain in the soil in the Buffer Zone and Crossroad property after the more recent grading activities conducted by AAA Trailer are unknown at this time. Additional soil sampling to determine current conditions with respect to radionuclide occurrences in soil beneath the Crossroad property will be conducted as part of implementation of the selected remedy for this area.

2.2.1.4 Summary of Radiological Occurrences

The total estimated area underlain by radiologically impacted materials in Areas 1 and 2 is approximately 28 acres. The total estimated volume of radiologically impacted materials, including the refuse, debris, and fill materials and unimpacted soils that are present in the same depth interval and are co-mingled with the radiologically impacted materials, is estimated to be 146,000 cubic yards.

2.2.2 Non-radiologically Impacted Materials

As part of the investigation of radiological occurrences in Areas 1 and 2, investigations of occurrences of non-radiological occurrences were also performed. Occurrences of non-radiological constituents in Areas 1 and 2 are not associated with radiological occurrences.

2.3 Potential Migration Pathways

This section of the FS summarizes the potential migration pathways of radiological constituents from Areas 1 and 2 that were evaluated by the RI. The possible pathways by which radionuclides potentially could migrate from Areas 1 and 2 include:

- Airborne transport of radon gas, transport of radionuclides in fugitive dust, or subsurface migration of radon and volatile organic compounds (VOCs) with landfill gas;
- Rainwater runoff transport of radionuclides dissolved or suspended in on-site or offsite surface water or rainwater runoff;
- Erosion of Area 1 and 2 soils and transport of radionuclide impacted soils in sediment; and
- Leaching of radionuclides to perched water and discharge at the leachate seep or leaching of radionuclides into the underlying alluvial groundwater and groundwater transport to offsite areas.

The summary of potential migration pathways presented in the following sections reflects the current conditions at the site. Potential future changes in the use of the property or the physical integrity of Areas 1 and 2 could result in a deterioration over time that could potentially change the possible migration pathways if appropriate measures are not taken.

2.3.1 Airborne Transport

Radon flux measurements obtained during the RI indicated that the radon flux levels from Areas 1 and 2 did not exceed the standard of 20 pCi/m^2s (which is applied as an average to the entire area of interest) established pursuant to the UMTRCA for radon emissions from residual radioactive materials from inactive uranium processing sites (40 CFR 192.02(b)). The presence of radon emissions from OU-1 indicates that these emissions may be a migration pathway of concern; however, testing performed during the RI indicated that the overall radon emissions from the landfill are below the standard. Mixing of radon with landfill gases and lateral migration from Area 1 or 2 through the landfill materials does not appear to be a migration pathway of concern based upon measurements of radon concentrations in the landfill gas collection system.

Fugitive dust monitoring was conducted at one location in Area 1 and one location in Area 2 in accordance with the EPA approved RI/FS Work Plan (McLaren/Hart, 1994). Sampling for fugitive dust monitoring was performed at locations that contained the highest or some of the highest radionuclide concentrations in surface soil samples. Results of the fugitive dust monitoring indicated that although fugitive dust emissions may be a potential pathway at the landfill, the levels of radionuclides detected in the fugitive dust samples collected during the RI indicated that it is not a significant pathway for radionuclide migration from Areas 1 and 2 (EMSI, 2000). Fugitive dust is not considered a significant pathway for radionuclide migration under current conditions, primarily because the surfaces of Areas 1 and 2 are for the most part vegetated thereby reducing or preventing release of significant amounts fugitive dust. This pathway could become a concern in the future if the site conditions are not monitored and maintained.

Methane gas measurements were performed as part of the RI field investigations. During the RI, methane levels ranging from less than 1% to as much as 45% were observed in the various boreholes drilled for the RI. The highest levels of methane were observed in boreholes drilled in Area 1. Lower levels of methane were observed in Area 2; however, methane concentrations greater than 5% methane concentration by volume (the lower explosive limit or LEL for methane) were observed in both Area 1 and Area 2. The active portion of the West Lake Landfill has a methane gas collection and treatment system.

2.3.2 Runoff and Erosional Transport

Precipitation that falls on the surface of OU-1 has the potential to transport site constituents in the form of runoff water (water phase) or soil erosion associated with slope failures or mud flows (soil phase). As part of the RI, samples of rainwater runoff and sediment were obtained to assess the current potential for transport of radionuclides by these mechanisms. Rainwater runoff and sediment samples were obtained from various surface water diversion ditches, runoff control structures or erosional channels located both onsite and offsite within or adjacent to Areas 1 and 2 in accordance with the EPA-approved RI/FS Work Plan (McLaren/Hart, 1994).

As radionuclides are present in the surface soil in Areas 1 and 2, a potential for transport of radionuclides as suspended sediment or in dissolved phase exists in response to runoff of precipitation (rain or snow) that falls on the surface of Areas 1 and 2. The first subsection below (Section 2.3.2.1) summarizes the results of water sampling and evaluation of the potential for radionuclide transport by runoff water (either in the dissolved phase or as suspended sediment in water). This discussion is focused on review of the results of filtered (dissolved phase) and unfiltered (total phase) water samples to assess the potential for migration in the water phase. The second subsection below (Section 2.3.2.2) summarizes the results of soil and sediment sampling as they relate to the potential for soil erosion and transport of soil containing radionuclides from OU-1. This discussion is focused on review of the results of soil and sediment (solid phase) samples. As discussed previously (Section 2.2.1.3 and more fully in the RI [EMSI, 2000), erosion of soil from Area 2 after completion of landfilling in Area 2 resulted in transport of radionuclides onto the adjacent Ford (now Buffer Zone and Crossroad property) property indicating that at least historically, erosional transport either through slope failure or mudflow was a pathway for transport of radiologically impacted soil from the Site.

2.3.2.1 Rainwater Runoff Transport

This subsection addresses the potential for runoff water to contain and transport radionuclides from OU-1. Water samples were obtained during storm events to assess the potential for dissolved or suspended phase transport of site contaminants in precipitation runoff. Radionuclides were detected in some of the rainwater/runoff samples obtained as part of the RI.

As no standards or health-based criteria exist for rainwater/runoff, the results of the analyses of these samples were compared to the Maximum Contaminant Levels (MCLs) for drinking water systems; however, as there is no expectation that any potential receptor would actually drink rainwater/runoff, the MCLs are not an ARAR for rainwater/runoff. One of the rainwater/runoff samples obtained from an onsite area contained radionuclides at levels slightly above the radium MCL. The analysis of this sample indicated that the total of radium-226 and -228 isotopes in the unfiltered sample was twice the MCL;

however, the filtered sample contained radium levels far below the MCL. This indicates that the primary mechanism for rainwater runoff transport is transport of suspended sediment. Suspended sediment transport is limited to areas where sufficient water velocity occurs to keep the sediment in suspension. None of the surface water samples (either dissolved or total fractions) collected from the nearest offsite surface water bodies (surface water retention and detention basins and flood control channel located adjacent to the Site) contained radionuclides at levels above MCLs. The potential for radionuclide transport in either the dissolved phase or as suspended sediment in rainwater runoff during average storm events is likely limited by the presence of the existing vegetative cover. Therefore, dissolved phase transport in rainwater runoff does not appear to be a significant potential pathway for radionuclide migration. Suspended sediment transport in rainwater runoff is a potential pathway for radionuclide migration within and adjacent to Areas 1 and 2; however, based on the results of the offsite sampling, it does not appear to be a significant pathway for offsite migration of radionuclides.

2.3.2.2 Soil Erosion and Sediment Transport

This subsection addresses the potential for soil erosion during storm events to result in transport of radionuclides from OU-1. Sediment samples were collected from various surface water diversion ditches, runoff control structures or erosional channels located onsite and offsite. Some of the sediment samples collected on-site contained levels of radionuclides above background. One sediment sample collected at the landfill boundary on the southern side of the access road contained radium-226 at a level of approximately 5 pCi/g above background. The levels of radionuclides detected in offsite sediment samples were generally near or just slightly above background levels.

Previous erosional transport (slope failure or mudflow) from the western portion of Area 2 down the landfill berm resulted in transport of radionuclides onto the eastern portion of the buffer property and portions of the Crossroad property located adjacent to the base of the landfill slope on the northwestern boundary of Area 2. Soil samples obtained from five of the eleven locations on the Buffer Zone/Crossroad properties contained radionuclides at levels of 5 pCi/g or more above background. All of these samples were from the upper 3 to 6 inches of materials. Radionuclides were not detected above background levels in any of the soil samples obtained from the Buffer Zone/Crossroad properties at depths of one-foot or more. As previously discussed (Section 2.2.1.3), surface soil within this area was scraped and placed in stockpiles sometime during 1999. Subsequent testing did not detect the presence of any radionuclides above reference levels in any of the samples obtained from the Crossroad property and only one sample from the Buffer Zone contained radionuclides above reference levels.

Additional grading and placement of gravel occurred subsequent to the most recent soil sampling performed on Lot 2A2 and the Buffer Zone. The disposition of the soil piles created by the 1999 grading of this area is not precisely known; however, AAA Trailer has reported that the soil was pushed into a pile in the northeast corner of the Buffer Zone

near monitoring well WL-206. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use is still present beneath Lot 2A2 and the Buffer Zone.

Historic erosion of surface soil from Area 2 resulted in offsite transport of contaminated soil onto the adjacent Buffer Zone and Crossroad property. Based on this historic occurrence, erosional transport of soil in response to major storm events is considered to be a potential pathway. Based on the results of the sediment and offsite soil sample analyses, erosion of surface soil from Areas 1 and 2 and subsequent sediment transport has resulted in offsite migration of radionuclides from Areas 1 and 2. Soil erosion and sediment transport is also considered a potential pathway for future migration of radionuclides from Areas 1 and 2 during extreme precipitation events.

2.3.3 Leaching to Groundwater and Groundwater Transport

Perched water is present at isolated locations within the landfill materials in Areas 1 and 2. Radionuclides generally were not detected in the samples of perched water. The only radionuclides that were detected in perched water samples were at very low concentrations, approximately 1 to 2 pCi/l or less.

Groundwater monitoring was performed during 1995, 1996 and 1997 as part of the RI and during 2004 in conjunction with the FS. The results of the RI and the additional groundwater sampling indicated that radium is present in two OU-1 wells, D-3 and D-6 (Figure 2-9) at levels slightly greater than the MCL of 5 pCi/l for the total of Radium-226 and -228 isotopes. Benzene was detected in two OU-1 wells (I-2 and I-9) more than once at levels above the MCL (5 ug/l). Chlorobenzene was detected in well D-14 during the RI and in well D-85 during the additional sampling at levels above 100 ug/l. During the RI, arsenic was detected in three wells (MW-F3, S-10 and D-14) at levels above the MCL of 50 ug/l.

Missouri has promulgated a Maximum Contaminant Level (MCL) of 5 pCi/L for radium-226 and radium-228 combined (10 CSR 60-4.060 “Maximum Radionuclide Contaminant Levels and Monitoring Requirements”). Site data were compared to these standards to assess whether potential exposure to the measured concentrations is significant. The levels of radionuclides detected in groundwater beneath and adjacent to Areas 1 and 2 generally were below both background levels and the State of Missouri MCLs for drinking water systems.

Groundwater monitoring performed during the RI and FS did not identify any wells containing uranium at levels close to or above the MCL. Monitoring did identify several wells with total radium concentrations close to the MCL (e.g., I-2, I-9, I-11, D-13, and D-93) and two wells, D-3 and D-6, (Figure 2-9) with total radium levels above the Missouri State MCLs for drinking water systems. The measured concentrations in both wells were just slightly greater than the MCL. Well D-6 is located in the Buffer Zone

immediately adjacent to the west side of Area 2. Based on all available data, it does not appear that the source of the radium occurrences in well D-6 is the result of either vertical migration from overlying soils or shallow groundwater, or lateral migration from upgradient groundwater. The RI concluded that the source of the radium levels in well D-6 was possibly the result of cross-contamination; that is dragging down of shallow impacted soil during drilling activities. Well D-3 is located in the western portion of Area 1. Radium was not detected in well D-3 at levels above the MCL during sampling performed for the RI; however, it was detected above the MCL during sampling performed in March and May of 2004 in conjunction with the FS. As radium was neither detected at levels above or even close to the MCL in wells (S-5 and I-4) completed at shallower depths at the same location as D-3 nor in any other wells in and around Area 1, the cause of the more recent reported occurrences of radium in well D-3 could not be identified.

Based on the monitoring data obtained during the RI leaching of radionuclides into groundwater and subsequent transport in groundwater to offsite areas is not currently considered to be a significant migration pathway. Although elevated levels of radionuclides and non-radionuclides have been detected in a few, isolated wells completed within or adjacent to OU-1 portions of the landfill, a plume or contiguous area of radionuclide or non-radionuclide constituent occurrences in groundwater at concentrations above regulatory standards or risk-based levels is not present at the West Lake Landfill. The lack of a plume of radionuclide contamination in groundwater at the Site is consistent with the relatively low solubility of most radionuclides in water and their affinity to adsorb onto the soil matrix. As radionuclides and non-radionuclide constituents have been detected in groundwater at levels slightly above MCLs and these constituents are present in the waste materials at the Site, leaching to groundwater is considered to be a potential future migration pathway that needs to be addressed as part of remedial action at the Site.

Uranium does possess a greater solubility than that of other radionuclides. Uranium isotopes (U-238 and U-234) have been detected in groundwater samples obtained from monitoring wells at the Site at levels of approximately 5 pCi/l or less. Uranium has also been detected in upgradient, background wells at levels up to approximately 2 pCi/l. EPA has established an MCL for uranium in public drinking water supplies (65 Fed Reg at 76708 [December 7, 2000]) of 30 ug/l (approximately 30 pCi/l) that became effective on December 8, 2003. The levels of uranium detected at the Site are below the 30 ug/l federal and Missouri (10 CSR 60-4.060) MCL for uranium.

Perched water discharges from the landfill surface in the western side of Area 2. Seepage that occurs in this area flows over the ground for a short distance prior to evaporating or infiltrating back into the underlying soil and waste. A sample of this leachate seep indicated that the radioisotopes present in the seep water were all below the Missouri State MCLs for drinking water supply systems. Based upon these results, the leachate seep is not a pathway for radionuclide migration. Furthermore, seepage discharge is not

considered a pathway for offsite migration because the water from the seeps does not migrate offsite.

In accordance with the EPA-approved RI/FS Work Plan (McLaren/Hart, 1994), groundwater samples obtained from monitoring wells located within or near to Areas 1 and 2 were also analyzed for a wide range of chemicals including trace metals, petroleum hydrocarbon constituents, VOCs, semivolatile organic compounds, pesticides and polychlorinated biphenyls (PCBs). With the exception of the trace metals, which are naturally occurring, only isolated detections (i.e., these constituents were only detected in samples obtained from a single well or in a some instances in only a few wells) at low concentrations were found in wells sampled in or near Areas 1 and 2. Being naturally occurring, trace metals were detected in a greater number of wells, particularly in the unfiltered samples which contained suspended sediment. Arsenic was the most frequently detected trace metal and was found in approximately one-half of the wells sampled. The majority of arsenic results were either non-detect or found at levels similar to those found in the upgradient (background) well samples. Additional discussion of the groundwater sampling results for both the radionuclides and the non-radiological parameters can be found in the RI (EMSI, 2000). Overall these data confirm that a plume of contaminated groundwater is not present beneath or downgradient of the landfill indicating that leaching to groundwater currently is not a significant pathway for transport of radionuclides or non-radiological constituents.

It should be noted that the above discussion is based on a simple comparison of measured values to water quality standards and does not reflect detailed evaluation to determine whether these comparisons are statistically significant based on comparison of average values to drinking water standards taking into account the uncertainties associated with water quality measurements at levels near standards. Given the limited number of wells and limited number of chemicals with values potentially greater than drinking water standards, additional evaluations were not considered necessary for completion of the RI/FS. Statistical evaluation of groundwater quality data may be required as part of long-term monitoring to assess whether groundwater beneath the Site meets or exceeds standards and whether any long-term increasing or decreasing trends in groundwater quality are occurring at the Site.

In summary, groundwater monitoring to date has shown limited impact on groundwater quality. Partitioning calculations based on published distribution coefficients were presented in the RI (EMSI, 2000) and indicated that impacts to groundwater over time may be low. Although the RI evaluations indicated that the current and the projected future impacts to groundwater were low, the RI was neither designed to, nor considered all of the investigations and evaluations that would be required to support definitive conclusions about the potential for contaminants to leach to groundwater over time. Therefore, leaching of radionuclides and possibly other chemicals such as metals or VOCs, to groundwater is considered to be a potential pathway of concern.

2.3.4 Summary of Potential Migration Pathways

The results of the RI investigations indicate that the radiological and non-radiological contaminants present in the OU-1 waste materials may not be fully contained. Radionuclides have been detected in samples of storm water runoff, primarily in the form of suspended sediment. Large scale erosion of impacted soil in Area 2 in the form of a slope failure or mud flow previously resulted in offsite transport of radiological contaminants onto the adjacent property. While groundwater monitoring to date has shown only isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, the RI was not designed to develop definitive conclusions about the potential of contaminants to leach to groundwater over time. Therefore, leaching to groundwater represents a potential migration pathway to be address by the remedial actions that may be taken at the Site. The presence of landfill gas (methane) within OU-1 provides a potential mechanism for VOCs and radon within Areas 1 and 2 to be transported to areas outside of OU-1.

2.4 Baseline Risk Assessment

A BRA was performed for Areas 1 and 2 and the adjacent Buffer Zone/Crossroad property (Auxier & Associates, 2000). The BRA included both a quantitative human health risk assessment and a screening level ecological risk assessment. The results of the BRA are summarized below.

2.4.1 Human Health Risk Assessment

The BRA (Auxier & Associates, 2000) identified eight radionuclides (U-238, U-235, Th-232) and their associated daughter products (U-234, Th-230, Ra-226, Pb-210, and Pa-231) as Chemicals of Potential Concern (CoPCs) based on their relatively long half-lives. Based on a review of the site data and a toxicity screening, three trace metals (arsenic, lead, and uranium as a metal) and one polychlorinated biphenyl (Aroclor 1254) were also selected as CoPCs for the human health risk assessment. Based upon a comparison to EPA screening values, other trace metals and organic compounds detected in the soil samples obtained from Areas 1 and 2 were not selected as CoPCs as the maximum detected values of these constituents did not exceed the risk-based screening levels.

Several potential human receptors were identified and evaluated in the BRA including a groundskeeper currently working adjacent to Areas 1 and 2, a groundskeeper that may work on Areas 1 and 2 in the future, and a current or future groundskeeper working offsite on the buffer/Crossroad properties. Potential receptors associated with possible parking, open storage or other uses of Areas 1 and 2 ancillary to potential future commercial/industrial uses in areas adjacent to Areas 1 and 2 were also evaluated. The potential pathways by which these receptors could potentially be exposed to contaminants present in Areas 1 and 2 included exposure to external radiation, inhalation

of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, or incidental ingestion of soil containing radionuclides or other chemicals.

Although groundwater within the alluvial aquifer in the area of the Site may be potentially usable, potential exposure to radionuclides through consumption of groundwater is not considered to be viable pathway of concern. The nearest drinking water well is located a large distance from the Site. Furthermore, all of the businesses and residences in the area use municipal drinking water supplies. Therefore, there currently is no use of shallow groundwater in the area of the Site and none is any expected to occur in the future. In addition, as discussed above, groundwater monitoring to date has shown only isolated occurrences of chemical and radiological constituents at levels slightly above MCLs.

Table 2-1 presents a summary of the results of the risk assessment evaluations. Based upon an assessment of the carcinogenic potential and systemic toxic effects associated with each of the CoPCs, combined with the exposure assessment scenarios, potential risks were calculated for each potential receptor. These calculations indicated that the potential exposure to external radiation for the hypothetical groundskeeper that currently could work adjacent to Areas 1 and 2 resulted in a carcinogenic risk of 1×10^{-5} for Area 1 and 4×10^{-5} for Area 2. These calculated risks were within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. No adverse systemic (non-carcinogenic) effects to the groundskeeper were identified. The potential risks to a hypothetical groundskeeper working on the Buffer Zone/Crossroad properties adjacent to Area 2 resulted in a carcinogenic risk of 6×10^{-7}, which is also within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

The potential risks to the future onsite groundskeeper working in Areas 1 and 2 were calculated at 6×10^{-5} for Area 1 and 2×10^{-4} for Area 2. The calculated risk for a future onsite groundskeeper working in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. As with the current exposure scenario, the calculated risk for a possible future exposure for a hypothetical offsite groundskeeper receptor (2×10^{-6}) was within EPA's accepted risk range.

Possible future uses of Areas 1 and 2 for parking lots, open storage, or employee recreation that may be ancillary to potential future commercial or industrial uses of portions of the landfill adjacent to Areas 1 and 2 were also addressed. The potential risks to a future user of a building that may be constructed adjacent to Area 1 or 2 (land use covenants prevent construction of a building on Area 1 or 2) were calculated at 1×10^{-5} for Area 1 and 4×10^{-5} for Area 2, both of which are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA. The potential risks to future worker that may be involved in outdoor storage uses on Area 1 or 2 were calculated to be 1×10^{-4} for Area 1 and 4×10^{-4} for Area 2. The calculated risk for a future worker involved in outdoor storage in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

Non-radiological CoPCs are not projected to cause unacceptable risks under either the current or future exposure scenarios. Uncertainties associated with the human health risk assessment were addressed through the use of conservative assumptions likely resulting in an overestimate of the actual risks that may occur.

Although the calculated potential risk levels, for the most part, are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA, the calculated risks for some of the potential future exposure scenarios are at the upper end of, or slightly exceed the generally acceptable risk range used by EPA. In addition, uncertainties exist regarding the possible exposure frequency and duration associated with potential future workers at the Site. Therefore, the BRA did not necessarily evaluate the reasonable maximum exposure.

Consistent with the current and reasonably expected future uses of the property, industrial, commercial and recreational future uses were considered in the BRA. The calculated estimates of the potential risk were also based on exposure scenarios that were limited in part by existing restrictions on current and potential future land uses (institutional controls) at the Site. The evaluations of potential current and future risk were based on the assumption that the existing land use restrictions remain in place as these restrictions cannot be revoked or modified without the consent of EPA and MDNR. Consequently, the risk assessment reflects a No Further Action scenario rather than a No Action scenario. Unrestricted use of the Site, including possible future residential use, was not evaluated as part of the BRA due to the likely industrial and landfill uses of the Site, the presence of land use covenants limiting future use, and requirements associated with post-closure regulations for solid waste landfills. Consequently, the BRA did not evaluate all possible exposure scenarios but rather included reasonably anticipated future uses.

As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations, infiltration into and erosion of these areas poses an overall potential risk to human health and the environment. Based on the BRA evaluations, the presence of radionuclides in OU-1 poses risks to potential future onsite workers that are at the upper end of or slightly exceeds the generally acceptable risk range used by EPA. In addition, the potential that the exposure duration and frequency for future onsite workers could be greater than those evaluated as part of the BRA suggests that risks to potential onsite workers could be greater than those calculated by the BRA. In addition, all possible future uses and exposures scenarios were not evaluated as part of the BRA. The presence of radionuclides and non-radiological contaminants in OU-1 poses an unacceptable risk to public health if institutional controls and the physical integrity of the disposal areas are not maintained or if future uses change.

2.4.2 Ecological Risk Assessment

The BRA included a screening level ecological risk assessment (ERA). There is a significant amount of uncertainty associated with the actual potential for ecological impacts. A screening level risk assessment deals with the uncertainty by using highly conservative assumptions when estimating potential risks, thus intentionally overestimating the potential risk significantly, sometimes by several orders of magnitude. Thus, while the screening level ERA indicates that a potential ecological risk may exist, the ERA also cautions that this does not mean that site-related chemicals are impacting ecological receptors.

After assessing the uncertainties, the ERA points out that Areas 1 and 2 currently support vegetative and animal communities with no observable impact to the plant communities. Vegetation in Areas 1 and 2 consists primarily of old field community (primarily grasses and herbaceous species with woody species present along the landfill berm in Area 2) interspersed with small areas of hydrophilic (herbaceous) vegetation within small depressions. Indications of the presence of deer, rabbits, coyotes and/or red foxes as well as various bird species were observed during the RI investigations. The ERA notes that the existing plant and animal communities are located within areas of landfill operations, and concludes that the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place.

The screening level risk assessment concluded that ecological receptors may be at risk from exposure to chemical contaminants, especially metals, in Areas 1 and 2. Small burrowing animals may be at risk from exposure to radioactive materials in Area 2. Metals present in soils may adversely affect plants and soil invertebrates. However, both Areas 1 and 2 currently support vegetative and animal communities and there is no observable impact to the health of the plant communities.

3 POTENTIAL ARARS AND REMEDIAL ACTION OBJECTIVES

This section of the FS describes potential ARARs associated with other environmental laws. This section also presents proposed RAOs for OU-1.

3.1 Potential Applicable or Relevant and Appropriate Requirements

CERCLA remedial actions must be analyzed for compliance with ARARs. This subsection identifies potential ARARs for the West Lake Landfill OU-1. Compliance with ARARs is one of the criteria used to evaluate potential remedial alternatives during the FS. The identification and evaluation of potential ARARs presented in this FS is intended to provide a basis for the development and detailed analysis of alternatives.

A requirement established under other environmental laws may be either "applicable" or "relevant and appropriate" to a remedial action, but not both. When determining the ARARs for a remedial action, a two-tier test may be applied. First, a determination of whether the regulation is applicable is made. Second, if the regulation is not applicable, then a determination of whether the regulation is nevertheless relevant and appropriate is made.

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site. Relevant requirements are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that do not directly and fully address site conditions but involve similar situations or problems to those encountered at a CERCLA site. Whether a requirement is appropriate (in addition to being relevant) varies depending on factors such as the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors. Only the substantive portions of a regulation are considered potential ARARs. Administrative or procedural requirements such as permitting or record-keeping requirements are not potential ARARs.

In accordance with the NCP, only those requirements that are both relevant and appropriate are considered as ARARs for evaluation of remedial alternatives (40 CFR 300.430(e)(9)(iii)(B)).

The NCP [40 CFR § 300.400(g)(2)] requires the following comparisons shall be made, where pertinent, to determine relevance and appropriateness:

(i) The purpose of the requirement and the purpose of the CERCLA action;
(ii) The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
(iii) The substances regulated by the requirement and the substances found at the CERCLA site;
(iv) The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site;
(v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
(vi) The type of place regulated and the type of place affected by the release or CERCLA action;
(vii) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action;
(viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

In the absence of promulgated laws and regulations, non-promulgated guidance or advisories can be considered when determining the level of cleanup to be achieved at a site. Such non-promulgated guidance or advisories are called "To Be Considered" (TBC) criteria. TBC criteria are advisories or guidance issued by the State or Federal government that are not legally binding requirements. Therefore, TBCs do not have the same status as potential ARARs, but TBCs are evaluated and considered for utilization where no ARARs exist. Examples of TBCs include peer reviewed health effects information, guidance documents, or policy documents. Although TBCs are not required to be achieved by law in the same manner as ARARs, compliance with TBCs may be required if necessary for the protection of human health or the environment. The determination of applicability, relevance and appropriateness, and compliance with TBCs is made on a case-by-case basis.

Clean-up actions must comply with the ARARs selected for a site unless a waiver is granted in the ROD based upon the statutory requirements of CERCLA Section 121(d)(4). Waiver requirements are summarized below:

- Interim remedy – Compliance with an ARAR can be waived if the remedial action is only a part of a total remedial action that will attain the ARAR when completed.

- Greater risk – Compliance with an ARAR can be waived if compliance with the ARAR would result in greater risk to human health and the environment than the alternative selected.

- Technical impracticability – Compliance with an ARAR can be waived if it is technically impracticable from the perspective of engineering design.

- Equivalent standard – Compliance with an ARAR can be waived if the remedy selected will attain an equal standard of performance through use of another approach.

- Inconsistent application of State requirements – Compliance with an ARAR can be waived if the State has not consistently applied the requirement (or demonstrated an intention to apply consistently) in similar circumstances at other remedial actions.

- Fund balancing – This waiver is for Superfund financed actions only. Compliance with an ARAR can be waived in order to provide a balance between the need for protection at the site, and the availability of fund monies to respond to other sites.

ARARs are divided into three categories:

- Chemical-specific ARARs;

- Location-specific ARARs; and

- Action-specific ARARs.

3.1.1 Potential Chemical-Specific ARARs

Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements are generally health- or risk-based contaminant concentration limits or discharge limitations for specific environmental media. If a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied. State standards for protection against ionizing radiation are an example of potential chemical-specific ARARs. Evaluations of potential chemical-specific ARARs for West Lake Landfill OU-1 are presented on Table 3-1 and are discussed further below.

3.1.1.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

The Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subpart B) relative to standards for cleanup of land and buildings contaminated with residual radioactive materials from an inactive uranium processing site were evaluated as potential chemical-specific ARARs. These standards are not applicable as the West Lake Landfill is not a designated UMTRCA uranium processing

facility. The requirements in 40 C.F.R. Part 192 apply only to active and designated inactive uranium mill tailings sites and the West Lake Landfill is not (and never was) an active or designated inactive uranium mill processing site. The UMTRCA standards were developed for a different type of waste at different types of facilities than the low activity radioactive materials found in Areas 1 and 2. Although not applicable, the presence of radionuclides in OU-1 similar to those addressed by the UMTRA regulations suggests that portions of these regulations may be relevant and appropriate to potential remedial actions for OU-1.

The radiologically impacted material in Areas 1 and 2 represents only a very small portion of the total waste materials in these areas. Furthermore, the radiologically impacted materials are present within an overall matrix of municipal refuse, construction and demolition debris, and unimpacted soil. In addition, the uranium mill tailings standards are based on an unrestricted (i.e., potential residential) use of areas containing radium and/or thorium, not for solid waste disposal facilities such as the West Lake Landfill that have restricted use and have been and will continue to be used solely for commercial/industrial activities. Therefore, the waste materials in Areas 1 and 2 are not similar to uranium mill tailings or the situations addressed by the uranium mill tailings standards.

Certain aspects of these regulations may be potentially relevant and appropriate chemical-specific criteria for remedial action for OU-1. For example, the portion of these regulations addressing clean up levels for offsite impacted soil may be potentially relevant and appropriate criteria for remedial action, if any, involving excavation of radiologically impacted soil on the Buffer Zone/Crossroad properties. The portions of these regulations that establish standards of performance (radon emissions standards) for cover systems to be installed over radiologically impacted materials may potentially be relevant and appropriate chemical-specific criteria for the design of a cover system for Areas 1 and 2. Although not chemical-specific criteria, the portion of these regulations that established engineering design and performance standards for cover systems may potentially be relevant and appropriate action-specific criteria for remedial actions involving installation of an upgraded cover system over OU-1. Evaluation of the relevance and appropriateness of the chemical-specific requirements of the UMTRCA regulations to remedial action for OU-1 are discussed below. Evaluation of the relevance and appropriateness of the potential action-specific requirements of these regulations is presented in Section 3.1.3.1.

Three chemical-specific standards of 40 C.F.R. Part 192 may be potentially relevant and appropriate to potential remedial actions for OU-1. First, the UMTRCA standards state that control of residual radioactive materials and their listed constituents shall be designed to provide reasonable assurance that release of radon-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2s [40 C.F.R. § 192.02 (b)(1)]. For inactive sites, this standard can be satisfied alternatively by providing reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not increase the annual average concentration

of radon-222 in air at or above any location outside the disposal site by more than one-half picocuries per liter [40 C.F.R. § 192.02(b)(2)]. EPA also emphasized that averaging over the enormous piles was critical to the standard. It therefore explicitly stated that the average applies over the entire surface of the disposal site and over at least a one year period, which cannot exceed 100 years [40 C.F.R. §§ 192.02(b)(1) n.2, 192.32(b)(1)(ii) n.2]. According to EPA, it is the net radon from the entire pile that is of significance to health (48 Fed. Reg. at 45938). Therefore:

> daily and seasonal variations in radon emission are to be averaged over, since these are also not of significance to public health . . . this averaging may extend over longer periods to accommodate normal fluctuations in soil moisture content due to short-term climatic variations. Thus, the lowest recorded values of soil moisture content should not be used; rather, the average values are appropriate. Such averages should not, however, extend to times as long as the normal human life span, since that could result in a significant alteration in the level of protection of public health. Similarly, averaging performance over the entire period of longevity of the cover is not within the meaning of the standard.

EPA explicitly stated that events and processes that could significantly affect the average radon release rate from the entire disposal site should be considered [40 C.F.R. § 192.20(a)(1)]. Phenomena that are localized or temporary, such as local cracking or burrowing of rodents, need to be taken into account only if their cumulative effect would be significant in determining compliance with the standard [40 C.F.R. § 192.20(a)(1)].

The only monitoring requirement in these regulations applies during processing operations and prior to the end of the closure period. It does not apply to inactive sites. The licensee has to conduct monitoring using procedures described in 40 C.F.R. part 61, Appendix B, Method 115, or other methods at least as effective in demonstrating effectiveness of a permanent radon barrier in achieving compliance with the 20 pCi/m^2s flux standard [40 C.F.R. § 192.32(a)(4)(i)]. EPA does not intend continuous emissions monitoring (58 Fed. Reg. 60348). Rather, a single monitoring event may suffice to verify the design (*Id*). This monitoring requirement is not relevant and appropriate because Areas 1 and 2 are not large enough and because West Lake Landfill does not have the processing operations subject to the monitoring requirement. Radon monitoring was previously performed as part of the RI for OU-1. These results indicated that the overall radon emission from Areas 1 and 2 (21.8 pCi/m^2s based on the average of 50 test locations) slightly exceeded the 20 pCi/m^2s radon emission flux standard owing solely to the presence of three high values. The presence of radon at levels similar to the UMTRCA radon standard indicates that this standard may potentially be relevant and appropriate for OU-1. Remedial actions involving placement of additional cover material pursuant to EPA's presumptive remedy guidance (EPA, 1993b, see also Section 4.4.3 of this FS report) should meet the radon emission standard promulgated under UMTRCA.

Secondly, the concentration limits established under the groundwater protection standard of the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subparts A and B) present potentially relevant and appropriate standards for groundwater quality at the Site. The uranium concentrations observed in groundwater during the RI did not exceed or even come close to the standard of 30 pCi/l established by these regulations. With the exception of the total radium concentration in wells D-3 and D-6 (see previous discussion in section 2.3.3 of this FS), which slightly exceeded the standard of 5 pCi/l established by these regulations, the radium concentrations observed during the RI were also less than the standard established by these regulations. With the exception of arsenic levels in two wells, MW-F3 and S-84, dissolved concentrations of trace metals did not exceed the standards established by these regulations. There were some instances where the total (unfiltered) samples did exceed these standards; however, with the exception of the arsenic levels in the two wells identified above, analyses of the dissolved (filtered) fraction of these samples did not exceed the standards for any of the trace metals. Based on the presence of radioactive materials in OU-1 and the potential for leaching to groundwater, the groundwater protection standards (40 CFR 192.02(c)(3) and (4)) and monitoring requirements (40 CFR 192.03) of the UMTRCA regulations are potentially relevant and appropriate.

Third, the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subpart B) may potentially be relevant and appropriate requirements for the radiologically impacted soil that may be present on the Buffer Zone/Crossroad property. These regulations include standards for cleanup of land and buildings contaminated with residual radioactive materials from inactive uranium mills. As the West Lake Landfill is not and has never been an inactive uranium mill, these requirements are not applicable; however, as these regulations address the cleanup of soil contaminated with radium, they may be relevant and appropriate to any remedial actions that may be taken relative to the radiologically impacted soil on the Buffer Zone/Crossroad property. The surface (upper 15 cm) soil cleanup standard for radium-226 (no more than 5 pCi/g above background) and, in some cases, the subsurface standard (no more than 15 pCi/g above background) in 40 CFR 192 generally will be ARARs if excavation of soils contaminated with radium and thorium on the Buffer Zone/Crossroad properties is a component of the remediation alternative being considered. The standards in 10 CFR Part 40 Appendix A, I, Criterion 6(6) may also be considered relevant and appropriate to soil excavation from the Buffer Zone/Crossroad properties. In addition, EPA's guidance on the use of these soil standards for CERCLA cleanups are "to be considered" during evaluation and implementation of any soil remediation activities that may be performed based on a determination that the UMTRCA requirements are relevant and appropriate. Specifically, EPA's "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" (OSWER Directive 9200.4-25, February 12, 1998) [USEPA, 1998a] and "Remediation Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criteria in 10 CFR Part 40 Appendix A, I, Criterion 6(6)" (OSWER Directive 9200.4-35P, April 11, 2000) [USEPA, 2000a] should be considered during the design and implementation

of any soil removal activities that may be performed in offsite areas adjacent to Areas 1 or 2.

3.1.1.2 National Emissions Standards for Hazardous Air Pollutants

The National Emissions Standards for Hazardous Air Pollutants (NESHAPs) include standards for radon-222 emissions to ambient air from designated uranium mill tailings piles that are no longer operational. Specifically, radon-222 emissions from inactive uranium mill tailings piles should not exceed 20 pCi/m^2s (40 CFR 61 Subpart T). As West Lake Landfill OU-1 is not a designated uranium mill tailings site, this requirement is not applicable. As a portion of the waste materials in West Lake Landfill OU-1 do emit radon, the radon-222 NESHAP is considered to be potentially relevant and appropriate. As discussed above and as summarized in Section 2.3.1 of this report and in more detail in the RI (EMSI, 2000), radon emissions from OU-1 slightly exceeded (21.8 pCi/m^2s based on the average of 50 test locations) the NESHAP standard of 20 pCi/m^2s.

3.1.1.3 Missouri Radiation Regulations for Protection Against Ionizing Radiation

The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040) contain chemical-specific standards that under certain circumstances may be applicable or relevant and appropriate requirements for OU-1. The maximum permissible exposure limits standards for ionizing radiation are applicable to machines and materials that are sources of ionizing radiation and are not applicable to waste materials such as those found in OU-1. These regulations establish a maximum permissible dose for ionizing radiation of 5 mrem per year or 3 mrem per quarter to the entire body. As these regulations do provide standards for protection from radiation, they are potentially relevant and appropriate to the waste materials in OU-1.

Specifically, those portions of these regulations that address protection from radiation for persons inside of a controlled area may be relevant and appropriate to the protection of workers inside of Areas 1 and 2 during any remedial actions that may be undertaken. Similarly, those portions of these regulations that address protection from radiation for persons outside of a controlled area may be relevant and appropriate to the protection of other workers at the Site outside of Areas 1 and 2 and the general public during any remedial actions that may be undertaken.

These regulations also define maximum permissible exposure limits for occurrences of specific radionuclides in air at levels above background outside of controlled areas. These requirements are considered to be potentially applicable for protection of the public during implementation of any remedial action that may be undertaken. Specifically, these regulations would require perimeter air monitoring during implementation of any remedial action that may be undertaken at OU-1.

3.1.1.4 Missouri Maximum Contaminant Levels

EPA has established Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) pursuant to the Safe Drinking Water Act (40 CFR Part 141, Subparts F and G). Implementation of the requirements of the Safe Drinking Water Act in Missouri has been delegated to the State of Missouri and is the subject of regulations promulgated by the Missouri Department of Natural Resources (MDNR).

These regulations (10 CSR Division 60 Chapter 4) establish MCLs for public drinking water systems. As the West Lake Landfill does not operate a public drinking water system, these regulations are not applicable to the remedial actions under consideration for OU-1. As groundwater beneath the West Lake Landfill is part of a larger alluvial aquifer which could potentially be used for drinking water by private and/or public wells, these regulations are potentially relevant for remedial actions for OU-1. As these regulations identify maximum contaminant levels that are allowed in drinking water and some of the chemical constituents that are the subject of these regulations have been detected in one or more groundwater monitoring wells located within or adjacent to Areas 1 and 2, these regulations are potentially appropriate for remedial actions for OU-1. Specifically, the MCLs provide numerical standards against which the groundwater monitoring results obtained as part of the remedial action can be evaluated to assess the overall protectiveness of the remedy and the effectiveness of the various remedy components.

3.1.2 Potential Location-Specific ARARs

Location-specific ARARs are those requirements that relate to the geographical or physical location of the site or remedial action rather than the nature of the contaminants or the actions being taken. These requirements may limit the type of remedial actions that can be implemented, and may impose additional constraints on the remedial action. Floodplain restrictions and the protection of endangered species are examples of potential location-specific ARARs. Evaluations of potential location-specific ARARs are presented on Table 3-2.

In general, the potential location-specific ARARs are not considered to represent significant issues relative to the evaluation of potential remedial alternatives or the selection or implementation of potential remedial actions at the Site. The only identified location-specific ARARs of any significance are those related to floodplain management and proximity to airport runways.

The Buffer Zone and Crossroad property are located within the historic floodplain of the Missouri River. These areas are currently protected by levees that have been constructed along the river. Areas 1 and 2, the Buffer Zone and the Crossroad property are located within the extent of the floodplain identified by the FEMA. Specifically, these areas are located within the extent of the 500 year floodplain, portions of the 100 year floodplain

that are expected to flood to depths of less than one foot, or portions of the 100 year floodplain that are protected by levees (Figure 2-2). To the extent that any regrading or excavation of soil containing radionuclides are considered for these areas, mitigative measures may need to be taken to minimize any adverse impacts to the floodplain associated with such activities.

The RCRA Subtitle D regulations (40 CFR Part 258, Subpart B) contain requirements for new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 ft of any airport runway end used by turbojet aircraft or 5,000 ft of any airport runway end used by only piston-type aircraft. The landfills or expansions must demonstrate that the units are designed and operated so that the MSWLF unit does not pose a bird hazard to aircraft. MDNR regulations for solid waste management include a similar provision for sanitary landfills (10 CSR 80-3.010 (4)(B)(1)). The MDNR regulations do not include a similar provision for construction and demolition landfills.

Portions of the West Lake Landfill, including a portion of Area 1, are located within 10,000 ft of the end of the runway under construction as part of the expansion of the Lambert - St. Louis International Airport (Figure 3-1). The West Lake Landfill includes an operating landfill; however, Areas 1 and 2 are located in inactive closed portions of the landfill and therefore these requirements are not applicable. As the intent of the regulations is to control bird hazards, these requirements may potentially be relevant to remedial activities that could result in exposure of previously placed refuse that could attract birds and therefore present a potential hazard to aircraft. As discussed in Section 4 of this FS, there are several possible methods for construction of a new landfill cover over Areas 1 and 2, most of which entail placement of additional soil materials over the existing surface of the landfill. These regulations would not be appropriate requirements for this type of activity; however, one option to change the surface grades of Areas 1 and/or 2 entails cutting and filling of previously placed waste materials to achieve the necessary grades. The requirements of the RCRA Subtitle D regulations and MDNR regulations related to prevention of bird hazards may potentially be relevant and appropriate to alternatives that include regrading of existing waste materials if such materials present a potential to attract birds. Specifically, these requirements may potentially be relevant and appropriate if previously placed sanitary (putrescible) wastes are regraded but not if regrading is limited to construction and demolition debris.

3.1.3 Potential Action-Specific ARARs

Action-specific ARARs are technology-based requirements that define handling, treatment, disposal, and other procedures triggered by the type of remedial action under consideration. These requirements generally set performance or design standards for specific activities related to the management of wastes. These requirements are not triggered entirely by the specific chemicals at a site, but rather by the remedial activity selected to accomplish a remedy. For example, State regulations related to storage of radioactive materials are an example of potential action-specific ARARs that may be

required to be met for a remedy involving temporary storage of radioactive materials. Evaluations of potential action-specific ARARs are presented on Table 3-3. Three of the more significant potential action-specific ARARs (UMTRCA Standards, RCRA Subtitle C standards and RCRA Subtitle D standards) are discussed further below.

3.1.3.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

Part 192 of Title 40 of the Code of Federal Regulations provides for Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings. Subpart A of these regulations contains Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites.

Portions of these regulations that provide for closure performance standards may potentially be relevant and appropriate to remedial actions for OU-1. Specifically, to address longevity considerations, 40 CFR 192.02(d) requires that each disposal site "shall be designed and stabilized in a manner that minimizes the need for future maintenance." In developing this requirement, EPA was concerned with long-term hazards relating to misuse by man or disruption by natural phenomena. While large volumes of uniform sand-like tailings piled on the ground or in impoundments may be of concern due to misuse by man (for example, use of tailings as construction or fill material) or disruption by natural phenomena, Areas 1 and 2 containing low activity radioactive materials in the subsurface mixed with garbage, construction and demolition debris, and other wastes do not present a concern of misuse by man. For UMTRCA tailings piles, the longevity consideration is typically addressed through placement of a rock armoring layer over the upper surface of the tailings pile capping system. Placement of a rock armoring layer over the top of a solid waste landfill cover system is inconsistent with the landfill cover design criteria contained in Subtitle D. Solid waste closure requirements are generally more appropriate than the UMTRCA requirements for the conditions associated with OU-1. To address longevity considerations for OU-1 and long-term hazards relating to disruption of the disposal site by natural phenomena, the development of remedial alternatives will include an alternative(s) that incorporates a concrete debris layer to restrict bio-intrusion and erosion into the underlying landfilled materials to increase the longevity of the landfill cover.

3.1.3.2 RCRA Subtitle C

The Resource Conservation and Recovery Act ("RCRA") Subtitle C regulations provide performance standards for the treatment, storage and disposal of RCRA-hazardous wastes. (42 U.S.C. Section 6921(a); 40 C.F.R. Part 264, *et. seq.*) A waste is considered to be hazardous if it is a solid waste that either exhibits the characteristics of hazardous waste (i.e. toxic, reactive, ignitable or corrosive) or it is a waste listed by EPA as being hazardous. (40 C.F.R. Section 261.3.) As the portions of the West Lake Landfill

containing OU-1 were closed prior to the November 1980 effective date of RCRA Subtitle C, these requirements are not applicable.

EPA comments to the Draft Feasibility Study for OU-1 requested a site specific analysis of potential relevant and appropriate construction, maintenance and monitoring requirements applicable to final cover under the RCRA Subtitle C landfill closure regulations. While the RCRA Subtitle C landfill closure regulations appear to have potential relevance in that they contain requirements for capping undisturbed contaminated soil in place, none of the regulations are well-suited to OU-1 and as such should not be considered ARARs for OU-1.

The RCRA Subtitle C landfill closure regulations of 40 C.F.R. Part 264 provide as follows:

> Section 264.310 Closure and post-closure care.
>
> (a) At final closure of the landfill or upon closure of any cell, the owner or operator must cover the landfill or cell with a final cover designed and constructed to:
>
> (1) Provide long-term minimization of migration of liquids through the closed landfill;
> (2) Function with minimum maintenance;
> (3) Promote drainage and minimize erosion or abrasion of the cover;
> (4) Accommodate settling and subsidence so that the cover's integrity is maintained; and
> (5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. (40 C.F.R. 264.310(a).)[1]

The RCRA Subtitle C landfill closure regulations are designed to: a) control and mitigate significant risk to human health and the environment presented by hazardous wastes; b) control hazardous waste leachate migration, post-closure and off-site releases by requiring a liner, cover and leachate monitoring system; and c) close active landfills which have not yet settled or had major subsidence. These regulations are intended to apply to operational hazardous waste landfills and require the owner/operator to pre-select closure methods via an approved closure plan, which addresses the risks germane to hazardous wastes. In fact, Congress' primary goal in adopting RCRA was

[1]EPA authored a technical guidance document to implement the final cover requirements of 40 C.F.R. Part 264. *(EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments*, July 1989, EPA 530-SW-89-047 hereinafter, "Final Cover Guidance".) This guidance document calls for a stringent final cover design of at least three final cover layers: a) 60 cm of soil as a top layer, either vegetated or armored at the surface, b) granular or geosynthetic drainage layer with a hydraulic transmissivity of no less than 3×10^{-5} cm^2/sec., and c) a two-component low permeability layer comprised of one flexible membrane liner installed directly on a compacted soil component with an hydraulic conductivity no greater than 1×10^{-7} cm/sec.

"prospective" rather than directed at already-disposed waste within a land disposal unit (51 Fed Reg. 40577 (November 7, 1986).)[2]

EPA has indicated that it may be unnecessary to require compliance with the RCRA Subtitle C final cover requirements at a CERCLA site. EPA has specifically stated that "if the waste is generally of low toxicity and the contamination is dispersed over a large area that bears little resemblance to the discrete units regulated under RCRA Subtitle C", use of RCRA closure and Subtitle C covers may not be appropriate (53 Fed. Reg. 51447 [December 21, 1988]; see also 55 Fed. Reg. 8760 [March 8, 1990]).

In comparison, the constituents, landfill conditions, project scope, landfill size and historical background under consideration for OU-1 substantially differ from the RCRA Subtitle C closure goals for an active, hazardous waste landfill. (40 C.F.R. Section 300.400(g)(2).) These differences are analyzed below:

1. The BRA indicated risks for hypothetical exposures at the upper end or slightly exceeding the acceptable risk range.

The primary concerns addressed by the RCRA Subtitle C landfill closure regulations are the risks posed by handling and managing hazardous wastes. By definition a hazardous waste is,

> a solid waste or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may -
>
> (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or
> (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. (42 U.S.C. Section 6903(5).)

As such, the RCRA Subtitle C landfill closure regulations seek to minimize the risks unique to hazardous wastes such as "fires, explosions, production of toxic fumes and similar problems resulting from the improper management of ignitable, reactive, and incompatible wastes." (45 Fed. Reg. 33210 (May 19, 1980).) To address these concerns, the owner/operator of a hazardous waste landfill must develop a closure plan during the landfill's active life setting forward precise plans as to how the wastes will be managed, treated, removed, stored and/or monitored at closure. (40 C.F.R. Section

[2]For example, Missouri regulation specifically provides that state regulations apply to the owner/operator of a "permitted" hazardous waste treatment, storage or disposal facility. (10 CSR 25-7.264)(2).)

264.112.) The closure plan is then incorporated into the permit as a permit condition. (40 C.F.R. Section 264.112 (a).)

However, in the case of an unregulated landfill being addressed under CERCLA, the proposed remedial actions are developed based on the NCP. Among the tools used in the NCP process, the responsible parties develop a BRA in accordance with EPA guidance for human health and ecological risk assessments and identify the risks presented by the contaminated materials discovered at the subject site. (40 C.F.R. Section 300.430(d)(4).)

In this case, the risk assessment for OU-1 assessed and quantified risk for current and future exposure conditions using probable, hypothetical receptor populations. The BRA evaluated radiocarcinogenic and chemocarcinogenic risk by media type for each receptor. The BRA also identified potential exposure routes at OU-1, including external radiation, inhalation of dust and gas, dermal contact and incidental ingestion of soil (Auxier & Associates, 2000).

At OU-1, the BRA indicated risks for the future hypothetical exposure at the upper end or slightly exceeding the acceptable risk range. On a constituent-comparison basis, the materials contained at OU-1 do not present the same level of risk inherent in managing hazardous wastes. It is therefore inappropriate to consider the RCRA Subtitle C landfill closure requirements as ARARs since they are significantly more stringent than necessary to address the risks present at OU-1.

2. The RI was not designed to provide definitive conclusions about potential for contaminants to leach to groundwater over time.

The other major concern which the RCRA Subtitle C landfill closure regulations are designed to address is the risk presented by leachate formation, leachate migration, post-closure escape of hazardous waste, hazardous constituents, leachate contaminated run-off, and decomposition of hazardous waste products to the ground or surface waters (See e.g., 40 C.F.R. 264.111.) The hazardous waste regulations and the Final Cover Guidance contain EPA's two-part RCRA liquids management strategy, e.g., a) minimize leachate generation by keeping liquids out of the unit; and b) detect, collect and remove leachate within the unit (EPA, 1989). The cornerstone of the strategy is keeping water out of the landfill and the final cover requirements are designed to be sufficiently stringent to altogether prevent the infiltration of liquid.

The presumptive remedy for municipal landfills assumes a Subtitle D landfill cap will be installed and maintained over landfill sites. For OU-1, the Subtitle D cap will be protective against the potential for leaching in light of the limited impact shown by groundwater monitoring to date.

3. OU-1 is a large, pre-regulation landfill and has likely experienced all major settling and subsidence.

The RCRA Final Cover Guidance for hazardous waste sites provides for specific sloping requirements, a venting system and if necessary, an interim closure period to allow for major settling to occur which may result from drums rupturing and causing subsidence, or biodegradation of organic matter. These provisions are designed to ensure the integrity and structure of the landfill closure system. These requirements are not relevant and appropriate for the same reasons articulated in the additional evaluation of the RCRA Subtitle D and Missouri Solid Waste requirements.

As applied to OU-1, the landfill is large (the total parcel is approximately 200 acres) and is over 50 years old. No drums were identified as part of the RI that could potentially rupture and cause subsidence. Due to the landfill's age, it is likely that all major settling and subsidence has already taken place.

3.1.3.3 RCRA Subtitle D

As discussed in Section 4 of this FS report, the West Lake Landfill is a municipal solid waste landfill that is being evaluated for potential remedial actions pursuant to EPA's "Presumptive Remedy for CERCLA Municipal Landfill Sites" guidance (EPA, 1993b). As the primary focus of the presumptive remedy approach for solid waste landfills is source containment, the RCRA Subtitle D requirements (or MDNR equivalent requirements) represent the primary standards for design and implementation of the containment remedy. Specifically, the landfill cover design, gas control measures, maintenance, groundwater monitoring, and corrective action criteria of these regulations are potentially relevant and appropriate.

Pursuant to Subtitle D of the Resource Conservation and Recovery Act (RCRA), EPA promulgated minimum criteria, including capping requirements, upon closure of a landfill that apply to new landfills. The EPA's rule only applies to new facilities or expansions, it does not apply to existing units [56 Fed. Reg. 50978-51007 (Oct. 9, 1991)]. Therefore, the Subtitle D requirements are not applicable to OU-1 but as they address waste materials and situations similar to those found in OU-1, the requirements of these regulations may in part be relevant and appropriate for remedial actions for OU-1 as discussed further below.

Under RCRA Subtitle D, a state may promulgate more stringent regulations for landfills in that state, provided that the EPA approves of the state's regulations. Missouri is an approved state for providing regulations for landfills. Missouri promulgated its regulations in 1997 [22 Mo Reg 1008, (June 2, 1997)] and they became effective July 1, 1997. The Missouri landfill requirements establish closure requirements for existing sanitary landfills that close after October 9, 1991. In response to a comment made at the time Missouri proposed its closure requirements, MDNR stated that "[m]any of the changes in this amendment are not applicable to existing facilities that have existing permits and have already been constructed. It is not the intent of the department to

impose the requirements of the revised rule on existing facilities in an unreasonable manner." [22 Mo. Reg. 1008, 1008 (June 2, 1997) (Order of Rulemaking)]. The portion of the West Lake Landfill that includes OU-1 closed circa 1974. Therefore, the Missouri closure requirements are not applicable requirements for remedial action under CERCLA since they only apply to closure and post-closure plans for active landfills at the time the regulation was promulgated.

Although the RCRA Subtitle D requirements and the Missouri landfill closure requirements are not applicable to remedial action of OU-1, the NCP requires that an evaluation be made as to whether such requirements are, nevertheless relevant and appropriate. "For action-specific requirements, generally the test for relevance is whether the action contemplated at the CERCLA site is similar." [53 Fed. Reg. 51394-51436 (Dec. 21, 1988)].

The closure requirements of the Missouri landfill regulations specify final slope grades and cover requirements to minimize infiltration and erosion. Therefore, these requirements are considered to be potentially relevant and appropriate for remedial actions for OU-1.

The MDNR regulations require cover to be applied to minimize fire hazards, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance [10 CSR 80-3.010(17)(A)]. The MDNR regulations require that as each phase of a sanitary landfill is completed, a final cover system shall be installed at portions of existing sanitary landfills without composite liners. This final cover shall consist of at least two feet (2') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less overlaid by at least one foot (1') of soil capable of sustaining vegetative growth [10 CSR 80-3.010(17)(C)(4)]. Placement of soil cover addresses the requirements for minimization of fire hazards, odors, blowing litter, control of gas venting and scavenging. Placement of clay meeting the permeability requirement addresses the requirement for minimization of infiltration of precipitation. Placement of soil and establishment of a vegetative cover meets the requirement of providing for a pleasing appearance.

The MDNR landfill regulations also contain minimum and maximum slope requirements. Specifically, these regulations require the final slope of the top of the sanitary landfill shall have a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)]. MDNR regulations also require that the maximum slopes be less than 25% unless it has been demonstrated in a detailed slope stability analysis that the slopes can be constructed and maintained throughout the entire operational life and post-closure period of the landfill. Even with such a demonstration, no active, intermediate or final slope shall exceed $33^{1}/_{3}$%. The purpose of this requirement is to prevent slope stability or erosional failure of the landfill side slopes.

Portions of Area 1 and much of Area 2 contain slope angles of less than 5% and in some portions of Area 1 and much of Area 2 less than 2%. Portions of the landfill berm

located along the northern boundary of Area 1 and the western boundary of Area 2 contain slopes greater than 25%. Portions of the landfill berm on the west side of Area 2 also exceed $33^{1}/_{3}$%. In the early 1970's, a slope failure consisting of erosion and washout occurred in the central portion of the landfill berm on the west side of Area 2. This slope failure resulted in erosion, transport and deposition of radioactively impacted soil from Area 2 onto the adjacent Buffer Zone property.

As disposal activities in the OU-1 portions of the West Lake Landfill were completed over 25 years ago, future differential settlement of the surface of the landfill would appear not to be a concern based on the results of the evaluations described in the referenced article. However, as the MDNR regulations address slope angles of cover systems over solid waste landfills necessary for minimization of infiltration and erosion and OU-1 is part of a solid waste landfill, these requirements may potentially be appropriate for design of a new landfill cover for OU-1.

Correction of past erosional failure of a portion of the landfill side slopes is included in the scope of the potential CERCLA remedial action. Remedial alternatives have been developed to include regrading to increase the slope of the surface of OU-1 to 2% or 5% and to reduce the steeper portions of the existing landfill surface in OU-1 to 25% or less where possible. Remedial action alternatives that include a concrete rubble layer which would provide additional erosion protection, protection against biointrusion, as well as providing a marker layer for future identification of the Site as a disposal facility, have also been developed and evaluated in the FS.

The MDNR regulations are intended to regulate active landfill operations. The radionuclide occurrences in OU-1 of the West Lake Landfill are present in portions of the landfill that were closed circa 1974. As the MDNR regulations address active landfills and not retrofitting of closed landfills, it is reasonable to conclude that these regulations anticipate achieving the 5% slope requirement using refuse that is placed during operation of the landfill and not placement of significant thicknesses (5 to 10 ft or more) of soil across an entire landfill area after conclusion of the active landfill operations. Therefore, these requirements are not relevant to remedial action for OU-1. As the MDNR regulations address slope angles of cover systems over solid waste landfills necessary for minimization of infiltration and erosion and OU-1 is part of a solid waste landfill, these requirements are potentially appropriate for OU-1.

The MDNR requirements for cover design and minimum slope angle are potentially relevant and appropriate for construction of a new landfill cover. These regulations would address issues associated with potential pathways of concern to OU-1 (erosional transport, infiltration and leaching to groundwater) and therefore are related to the purpose of the potential CERCLA remedial actions and address media and substances similar to those addressed by the potential CERCLA actions. Although the purpose of these requirements was not intended to address radioactive emissions (e.g., gamma radiation) associated with OU-1, installation of an upgraded landfill cover would provide protection from radioactive emissions from OU-1.

The MDNR regulations are intended to address the design, operation and closure of active or new sanitary or construction demolition landfills and were not intended as standards for retrofitting previously closed landfills. However, the cover design, minimum slope angle requirements, and the maximum slope angle requirements of the MDNR regulations are intended to prevent slope stability or erosional failure of landfill slopes. The potential CERCLA remedial actions are intended in part to correct a previous erosional failure of a portion of the landfill slope and to limit infiltration and subsequent leaching of contaminants. Consequently, the minimum and maximum slope angle and cover design requirements under the MDNR regulations may be potentially relevant to the potential CERCLA actions. As the purpose of a landfill cover is to prevent infiltration and erosion, the cover design criteria are also potentially appropriate.

The MDNR landfill regulations refer to a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)]. During conversations between Mr. Evan Randall of Spencer Fane Britt & Browne, LLP and Mr. Frank Dolan of MDNR, Mr. Dolan indicated that the purpose of the minimum slope of 5% is to address potential settlement of a landfill over time and the creation of depressions in the landfill surface that would collect precipitation runoff and become areas of increased infiltration of precipitation. Mr. Dolan further indicated that MDNR previously required a 2% slope on the surface but based on "common observations" of settlement of closed landfills MDNR subsequently determined that this slope angle was not great enough to prevent ponding of water due to differential settlement. Mr. Dolan referenced an article by Dean K. Wall and Chris Zeiss in the Journal of Environmental Engineering (Vol. 121, No. 3, March 1995) as the only formal document that MDNR used to select the 5% slope. In this article, the authors state that the process of differential settlement will take place within a 20 to 30 year period after a landfill is closed. The article does not address what the slope angle should be on the final surface of the landfill after settling. Based on the fact that landfilling of the portions of the West Lake Landfill in which Areas 1 and 2 are located was completed approximately 30 years ago, differential settlement is not a concern because the majority of the differential settlement and compaction of the refuse has already occurred. Therefore, a 2% minimum slope should be sufficient to promote drainage and reduce infiltration of precipitation. As the 5% minimum final slope requirement was intended to be applied to active landfills and not retroactively applied to closed landfills, and given that the 2% slope is considered sufficient to promote drainage thereby reducing infiltration, the 5% final grade is not necessarily considered to be appropriate requirement. Furthermore, use of a 2% slope should result in a lower potential for erosion, increasing the life of the cover and overall longevity of the remedy compared to a 5% slope which would be subject to greater erosion potential.

3.1.3.4 MDNR CALM (DRAFT – September 1, 2001)

The MDNR draft Cleanup Action Levels for Missouri (September 1, 2001) (CALM) guidance document outlines a process for determining cleanup goals at Missouri sites with known or suspected hazardous substance contamination. The CALM process was

developed for hazardous substance contamination which is to be remediated under Missouri's Voluntary Cleanup Program (VCP) laws and regulations (10 CSR 25-15.010), as administered by MDNR's Hazardous Waste Program. This guidance has not been finalized by MDNR and therefore cannot be considered an ARAR for West Lake Landfill OU-1. Further, because West Lake Landfill OU-1 is a Federal Superfund site and is not being addressed under Missouri's VCP program, the CALM guidance document should not be regarded as a TBC criteria.

The CALM guidelines' Appendix E provides a format for implementing proprietary use controls at contaminated sites. Although CALM is not a legally binding requirement because it is (and may remain) a draft state regulation and not an approved and promulgated state regulation, the CALM Appendix E may provide a useful format for implementing use restrictions at the West Lake Landfill site.

3.2 Remedial Action Objectives

As part of the development of the Presumptive Remedy approach to CERCLA Municipal Landfills, EPA identified typical RAOs for the presumptive remedy (EPA, 1993b). The RAOs identified by EPA for the municipal landfill presumptive remedy include the following:

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from the source area; and
- Controlling and treating landfill gas.

The RAOs identified by EPA in the presumptive remedy guidance (EPA, 1993b) address the potential migration pathways and exposures identified in Section 2.3 for OU-1. The first objective of preventing direct contact with landfill contents addresses direct exposure to contaminated soil or waste materials. This objective will also include prevention of exposure to gamma radiation. The second and third objectives identified in the presumptive remedy guidance are directly applicable to OU-1. As a plume of contaminated groundwater does not exist beneath or downgradient of OU-1, the fourth objective is not applicable to OU-1; however, as limited occurrences of radionuclides have been detected in shallow groundwater beneath OU-1, groundwater monitoring may be a required component of any remedy that may be selected for the OU-1. As landfill gas (methane or methane plus VOCs) plus radon have been identified as potential issue

for OU-1, the fifth objective of controlling and treating landfill gas, including radon emissions from OU-1 is applicable to OU-1.

Based on application of the presumptive remedy guidance, the following RAOs have been identified for OU-1:

1. Prevent direct contact with landfill contents and exposure to radiation;

2. Minimize infiltration and any resulting contaminant leaching to groundwater;

3. Control surface water runoff and erosion and decrease the potential for erosion and subsequent transport of radiologically impacted materials; and

4. Control radon and landfill gas emissions.

4 TECHNOLOGY SCREENING AND ALTERNATIVES DEVELOPMENT

The beginning of this section of the FS describes the process used to screen technologies that are then used as components of potential OU-wide remedial alternatives. Potential OU-wide remedial alternatives are developed at the end of this section.

The process of identifying OU-wide remedial alternatives begins with identification of the potential scope of any remedial action. General response actions (GRAs) that may be applicable to the OU based on the results of the site characterization (Section 2) and the RAOs established in Section 3 are then identified. Potential remedial action technologies associated with each GRA that may be applicable to OU-1 and the RAOs are first identified and screened based on technical implementability. The resultant technologies are then evaluated based on anticipated effectiveness, implementability and relative cost to identify the most applicable technologies. These technologies are then combined to develop remedial action alternatives for OU-1 for the West Lake Landfill. In Section 5 of this FS, the remedial action alternatives are subjected to detailed analysis for the various factors required for evaluation in accordance with the NCP (EPA, 1990).

4.1 Technology Identification

Each GRA is identified in this section based on site conditions and the established RAOs. These GRAs are then used to identify potentially applicable technologies. The criteria for identifying potentially applicable technologies are provided in EPA guidance (EPA, 1988a) and in the NCP. A strong statutory preference for remedies that are reliable and provide long-term protection is identified in Section 121 of CERCLA, as amended. The primary requirements for a final remedy are that it be both protective of human health and the environment and cost effective. Hence, technology screening focuses on these two factors.

Media-specific GRAs are developed to address the RAOs established for a site or OU. Given the environmental setting and the nature and extent of contamination described in Section 2 and the RAOs and potential ARARs discussed in Section 3, a list of GRAs that may be applicable to OU-1 at the West Lake Landfill was assembled and is as follows:

- No action;
- Institutional controls;
- Monitoring;
- In-situ containment;

- Physical treatment/pretreatment in-situ;
- Chemical treatment/pretreatment in-situ;
- Removal (of soil from the buffer and Crossroad properties or of radiologically-impacted material within Areas 1 or 2);
- Physical treatment/pretreatment following Removal (subject to Removal being retained as a GRA);
- Chemical treatment/pretreatment following Removal (subject to Removal being retained as a GRA);
- Disposal (subject to Removal being retained as a GRA).

For each GRA, broad technology groups and specific process options that could be used to implement these actions are identified. Technologies refer to general types of actions (e.g., capping and covers). Process options refer to the specific processes within each technology type (e.g., soil cover). Information from the literature, including applicability, performance, removal efficiencies, operation and maintenance (O&M) requirements, implementability, and the relative cost of candidate technologies was considered in preparing the list of technologies and process options provided on Figure 4-1. USEPA's Presumptive Remedy for CERCLA Municipal Landfill Sites guidance (EPA, 1993b) was also used to identify technologies and process options. As discussed later in this section, No Action is included to provide a reference as a basis for comparison with the other alternatives that are developed.

4.2 Screening and Evaluation of Potentially Applicable Technologies

In this section, the universe of technologies and process options identified for each GRA is initially screened. The number of remaining technologies and process options is then further reduced through an evaluation process. Surviving technologies and process options are described at the end of this section.

4.2.1 Screening of Potentially Applicable Technologies

The universe of potentially applicable technology types and process options applicable to each GRA is initially reduced through screening based on technical implementability. The results from this initial screening based on technical implementability are also included on Figure 4-1. The following technologies and process options were eliminated because of various implementability issues discussed under the screening comments on Figure 4-1: advisories as institutional controls; all physical treatment/pretreatment in-situ

(dewatering/drying, nonthermal extraction, and thermal destruction); all chemical treatment/pretreatment in-situ (soil flushing and stabilization/solidification [S/S]); all physical treatment/pretreatment following removal; and contact extraction and S/S under the GRA of chemical treatment/pretreatment following removal.

4.2.2 Evaluation of Potentially Applicable Technologies

Technologies and process options considered technically implementable are evaluated in detail based on effectiveness, implementability (both technical and administrative), and relative cost as defined by the following factors:

- Effectiveness - in terms of protecting human health and the environment in both the short term and the long term;

- Implementability - in terms of technical feasibility, resource availability, and administrative feasibility; and

- Cost - in a comparative manner (i.e., lower, moderate, or higher relative to other technologies within the same GRA) for technologies of similar performance and implementability.

Technologies and process options that are not effective in protecting human health and the environment, that cannot be implemented because of the physical characteristics of the site or materials of concern, or that have a cost that is an order of magnitude greater than a similar technology, are eliminated during this phase. In accordance with EPA guidance (EPA, 1988a), effectiveness is the major emphasis of this evaluation. Less weight is provided to implementability and cost. The results of the evaluation of potentially applicable technologies are shown on Figure 4-2.

4.3 Potentially Applicable Technologies

The technologies and process options that were retained after the effectiveness, implementability, and cost evaluation shown on Figure 4-2 were assembled into combined OU-wide alternatives identified in Section 4.4. These potential technology types and process options are described and discussed in the following subsections.

4.3.1 Institutional Controls

EPA defines institutional controls as non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. Human exposure to radiologically-impacted materials in OU-1 could potentially occur from direct exposure

to the landfilled materials, exposure to impacted media or exposure to radiation from the radiologically-impacted materials. Activities that could potentially affect the integrity of any remedy implemented at the Site could include drilling, excavation or other surface disturbances or subsurface intrusions that could degrade the integrity of the existing or upgraded landfill cover or changes in surface water runoff patterns, intensity, flow or drainage system that could result in erosion of the existing or upgraded landfill cover.

Institutional controls will also provide the mechanism for insuring access to the landfill and as needed adjacent properties for purposes of performing operations, monitoring and maintenance activities for the remedy. Such controls will also provide a mechanism for EPA and/or MDNR access to the Site to inspect and monitor compliance with the remedy requirements and the overall effectiveness of the remedy.

In accordance with the NCP, institutional controls are generally used in conjunction with, rather than in lieu of, engineering remedies. Where the opportunity exists, institutional controls should be "layered" (i.e., use multiple institutional controls) or implemented in a series to provide overlapping assurances.

EPA recognizes four categories of IC mechanisms:

1. Proprietary Controls - these controls are based on state property law with the most common examples being easements and covenants;

2. Governmental Controls - these controls use the authority of an existing unit of government such as zoning and building codes;

3. Enforcement and Permit Tools - these legal tools include orders, permits and consent decrees; and

4. Informational Devices - these devices include deed notices and State registries or advisories.

Institutional controls are measures that minimize public exposure by limiting access to or use of contaminated areas. Institutional controls are effective as informational devices and can constitute an enforceable property interest, but institutional controls do not preclude access to or use of property. Institutional controls do not reduce contaminant toxicity, mobility, or volume, but they can reduce the potential for exposure to contaminated material. Institutional controls, such as land use covenants, and limitations on groundwater use, are used as appropriate to supplement engineering controls such as fencing or containment to prevent or limit exposure to affected environmental media and/or to ensure the effectiveness of other response actions. Institutional controls can include both on-site and off-site institutional controls.

Property use restrictions at the West Lake Landfill Site will be implemented through the placement of institutional controls. The specific institutional control design and

implementation strategy will be a component of the remedial design planning process following release of the OU-1 Record of Decision by EPA. Where appropriate, multiple mechanisms, or a "layered" approach, will be used to enhance the effectiveness of the institutional control strategy. See above for the general categories of institutional control mechanisms.

At the West Lake Landfill Site, the affected properties are privately owned and the use restrictions must be maintained for a long period of time. Therefore, proprietary controls should be considered because they generally run with the land and are enforceable. The primary examples of proprietary controls, covenants and easements, are based in real property law and generally create legal property interests. This involves placing a legal instrument in the chain of title of the property. A property interest may be conveyed from the property owner (grantor) to a second party (grantee) for the purpose of restricting land or resource use. These types of controls can be binding on subsequent purchasers of property giving them a measure of long-term reliability.

Covenants under common law are typically promises to do something (affirmative) or not to do something (negative) with regard to the land. In case of a breach of the covenant, contract law usually applies. This means that the available remedies in case of a breach of the covenant would generally be limited to monetary damages.

Restrictive covenants may be an effective tool for implementing and enforcing the use restrictions established as part of the remedy for the West Lake Landfill Site. Easements, allowing the easement holder to enter or use property for a stated purpose, could be useful for adjacent property, e.g., the Crossroad property, to secure access rights for any long-term monitoring or maintenance needs.

The institutional control component (Appendix E) of the MDNR CALM draft regulations consists primarily of a restrictive covenant with an easement provision that allows MDNR access to a site for the duration of the restrictive covenant for the purpose of conducting periodic inspections. As grantee, MDNR has the authority to enforce the restrictive covenant. CALM Appendix E requires that the restrictive covenant state the intention of the property owner to make the covenant and the easement effective in perpetuity or until the MDNR determines that they are no longer necessary. This type of language ensures that a court will interpret the restrictive covenant and easement to run with the land and be binding on a current owner and all subsequent owners of the property, regardless of any case law that might support a different conclusion. As such, the CALM Appendix E language provides a useful format for implementing use restrictions at the West Lake Landfill site, including the requirement that a property owner sign and record the restrictive covenant with the Recorder's Office in the county in which the property is located.

In addition to the above proprietary controls, the MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 C.S.R. 23-3.010) prohibits the placement of a well within 300 feet of a landfill.

These rules should provide an additional layer of protection against the placement of wells on or near the West Lake Landfill.

Also, the West Lake Landfill site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Registry). The Registry is maintained by the MDNR pursuant to the Missouri Hazardous Waste Management Law, Mo.Rev.Stat. Section 260.440. Sites listed on the Registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property. The remedial design Work Plan will contain an institutional control design and implementation plan specifying the institutional controls and identifying the steps necessary to implement proprietary controls. At a minimum, the controls will provide detailed descriptions of the types and locations of the residual contaminants, the parties involved, provisions for third party enforcement, the parties' rights, the resource/use restrictions, language to assure that the institutional controls are binding on subsequent purchasers, and specific notice and approval requirements for modifying or terminating a control. Title documentation also generally will be required.

The Operation and Maintenance (O&M) Plan will contain procedures for surveillance, monitoring and maintenance of the institutional controls. The O&M Plan will provide for notice to EPA and/or the state of any institutional control violations, planned or actual land use changes, and any planned or actual transfers, sales or leases of property subject to the use restrictions.

The use restrictions or institutional controls objectives described below apply to all cap alternatives meeting the Subtitle D cover system requirements (*i.e.*, L4, L5, and L6). These restrictions must be maintained until the remaining hazardous substances at the Site are sampled at levels allowing for unlimited use and unrestricted exposure. These use restrictions do not apply to activities related to the implementation, maintenance, monitoring or repair of the remedy.

These use restrictions should apply within the boundary of the cover system(s) for Area 1 and Area 2, including all bordering buffer areas (OU 1 Area).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Prevent development and use for industrial or commercial purposes, such as manufacturing, offices, storage units, parking lots or other facilities, that are incompatible with the function or maintenance of the landfill cover.

3. Prevent construction activities involving drilling, boring, digging, or other use of heavy equipment that could disturb vegetation, disrupt grading or drainage patterns, cause erosion or otherwise compromise the integrity of the landfill cover, or manage these activities such that any damage to the cover is avoided or repaired.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

The use restrictions for adjacent disposal areas will be identified under the West Lake Landfill OU 2 Feasibility Study or as part of implementation of post-closure regulations for the permitted portions of the landfill. Coordination across operable units will ensure that use restrictions are complementary.

The following use restrictions should apply to the non-disposal areas of the West Lake Landfill site.

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas. Under this scenario, the use restrictions listed under letter A, above, will encompass the impacted area of the Ford property and no additional use restrictions will be necessary to address this property. Soil sampling will be undertaken to support the remedial design and confirm these assumptions.

4.3.2 Access Restrictions

Access restrictions generally involve physical barriers to entry such as fences and guards. These barriers are intended to prevent access to controlled areas. They serve to minimize the potential for deliberate or inadvertent trespass into controlled areas. The entire landfill site is fenced to control access to the Site. Maintenance of the existing fencing is considered an integral part of the remedial actions developed for OU-1. Additional

fencing around Areas 1 and 2 is considered a potential additional measure to further control access to these areas.

4.3.3 Monitoring

Monitoring is a process option that is expected to be a component of each remedial alternative discussed in Section 4.4, except the No Action alternative. Monitoring may serve the purpose of evaluating contaminant levels and migration and, depending on the remedial action selected, to evaluate the performance and effectiveness of any remedial action technology or process option employed.

4.3.4 In-Situ Containment

In-situ containment consists of technologies that confine contaminated media at their current locations. These technologies reduce contaminant mobility and the associated potential for exposure, but they do not reduce contaminant toxicity or volume. In-situ containment technologies include surface controls/diversions, surface water/sediment control barriers, dust controls, and caps and covers.

Surface controls/diversions are used to divert surface runoff around contaminated areas to minimize potential for contact of surface water runoff with impacted soils or for contaminant re-suspension. Graded contours, swales, and berms can effectively control surface water runon and runoff and can limit the mobility of contaminants. Sedimentation basins could also be used in conjunction with surface controls/diversions for surface water control. These measures would not, however, be effective for any off-site surface waters that are hydrologically connected to each other and to the local groundwater system.

A contaminated area can be encapsulated by placing low permeability surface seal barriers such as caps and covers on top of the area. Capping of soil and sediment could effectively limit airborne emissions and reduce precipitation-enhanced percolation, infiltration, and leaching. A variety of materials can be used in the construction of caps and covers depending on the design considerations for the cap or cover including soils, admixtures, and synthetic membranes. Factors influencing the selection of materials and design include the desired functions of cover materials, waste characteristics, climate, hydrogeology, projected land use, and availability and costs of cover materials.

For Areas 1 and 2 of OU-1 at the West Lake Landfill, asphalt or concrete covers were screened-out because of potential cost and maintenance requirements and are inconsistent with the cover design requirements of the Subtitle D regulations. Synthetic membrane and multilayer/multimedia material covers were also screened-out because they are inconsistent with the existing landfill cover and cover requirements. Soil, clay, and vegetation layer covers were retained. In addition for Areas 1 and 2, surface preparation

such as filling of surface depressions may be required prior to any cap or cover placement.

4.3.5 Excavation

Excavation of radiologically-impacted material can limit contaminant mobility and volume at the affected area of concern and can facilitate treatment and disposal that could reduce contaminant toxicity, mobility, and volume. Excavation can be applied to affected media at the site, and the appropriate technology and process option is a function of the physical properties of the medium.

Excavation with conventional earth-moving equipment (e.g., bulldozers, backhoes, scrapers, and front-end loaders) can effectively remove bulk material such as radiologically-impacted surface soil on the buffer/Crossroad properties. In addition, consideration must be given to the type and composition of material to be excavated, which can affect the size of the excavation and the ability to separate the radiologically impacted soil from other fill material.

Excavation of radiologically-impacted materials within Areas 1 and 2 is generally not considered feasible as the radiologically impacted soils are contained within an overall matrix of municipal solid waste, debris and other fill material. Physical removal of radiologically-impacted soils would require excavation of large volumes of solid waste to remove small volumes of affected soil. Such activities could result in strong odor emissions. Furthermore, separation of soil (both impacted and non-impacted) from solid waste materials would necessitate screening of the excavated materials. Screening of refuse is a very labor intensive activity due to the need to physically remove plastic and other debris that fouls the shaker screen. Cleaning of the screen could expose workers to gamma radiation under conditions that would be difficult to provide adequate protection.

Although wholesale excavation of the radiologically-impacted materials within Areas 1 and 2 is generally not considered feasible, this FS includes selective excavation of radiologically impacted materials containing higher levels of radionuclides as a potential remedial technology. Excavation of radiologically impacted soil that may still remain on the Buffer Zone and Crossroad property, if any, and consolidation of that excavated soil in Area 2 is also considered. Excavation of Buffer Zone and Crossroad property soil could be performed using standard construction equipment and techniques including a bulldozer and loader to scrape and load the soil into trucks that would subsequently transport the excavated soil to Area 2. Alternatively, scrapers could be used to excavate, transport and stockpile the soil.

4.3.6 Disposal

If the selected remedy were to include excavation of portions of Area 1 or 2 for offsite disposal, the radiologically-impacted material removed from the Site would be transported to a permitted off-site facility for disposal. Disposal of commercial (non-Department of Defense) low-level radioactive waste is governed by the Low-Level Radioactive Waste Policy Act of 1980 (Public Law 96-573) and the Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240) which gave the states responsibility for disposal of their low-level radioactive waste. The Act encouraged the states to enter into compacts that would allow them to dispose of waste at a common disposal facility. Most states have entered into compacts; however, no new disposal facilities have been built since the Act was passed.

Missouri, along with the states of Indiana, Iowa, Minnesota, Ohio, and Wisconsin, is a member of the Midwest Interstate Low-Level Radioactive Waste Compact. There are no permitted low-level radioactive waste disposal sites within any of the member states of the Midwest Interstate Low-Level Radioactive Waste Compact. Consequently, disposal of low-level radioactive waste generated within the compact states must be disposed outside of the compact.

Only four active, licensed low-level radioactive waste disposal facilities exist in the United States. These include the Chem Nuclear facility in Barnwell, South Carolina, the Envirocare of Utah facility near Clive, Utah, the Envirosafe facility in Idaho, and the Hanford Low-Level Radioactive Waste facility operated by U.S. Ecology. The Chem Nuclear site accepts waste from all U.S. generators except those in the Rocky Mountain and Northwest compacts. Beginning in 2008, this facility will only accept waste from the Atlantic Compact states (Connecticut, New Jersey, and South Carolina). The Envirocare and Envirosafe facilities accept wastes from all regions of the United States. The Hanford site only accepts wastes from the Northwest and Rocky Mountain compacts. Consequently, only three licensed commercial waste disposal facilities, Chem Nuclear, Envirosafe, and Envirocare, could currently accept radiologically impacted material that may be excavated from the West Lake Landfill for offsite disposal.

Several former uranium mills, such as International Uranium (USA) Corporations White Mesa Mill near Blanding, Utah, accept low-level radioactive wastes that can be reprocessed for recovery of uranium. The radiologically impacted materials at the West Lake Landfill contain uranium in addition to thorium and radium and therefore may be suitable for acceptance for re-processing at an uranium mill; however, the presence of refuse and other solid wastes within which the radionuclides are present make these materials unsuitable for re-processing at an uranium mill.

4.4 Development of Alternatives

In this section, technologies and process options retained in Section 4.3 are assembled into remedial alternatives. This section describes the statutory requirements related to remedial alternative development, EPA's presumptive remedy approach to CERCLA municipal landfill sites such as the West Lake Landfill, an evaluation of potential "hot spot" remediation, and the remedial alternatives for OU-1.

4.4.1 NCP Requirements for Remedial Alternatives

For source control actions, the NCP (EPA, 1990) requires the following types of alternatives to be developed as appropriate:

- A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element;

- Other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed;

- One or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to hazardous substances, pollutants, or contaminants, through engineering controls, for example, containment, and, as necessary, institutional controls to protect human health and the environment and to assure continued effectiveness of the response action;

- One or more innovative treatment technologies for further consideration, if those technologies offer the potential for comparable or superior performance or implementability, fewer or less adverse impacts than other available approaches, or lower costs for levels of performance similar to that of demonstrated treatment technologies; and

- A no-action alternative.

4.4.2 Presumptive Remedy Approach for CERCLA Municipal Landfills

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. The preamble to the NCP identifies municipal landfills

as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment is usually impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites.

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedy approach is to use the Superfund program's past experience to streamline site investigation and accelerate selection of cleanup actions. EPA has issued guidance that establishes containment as the presumptive remedy for CERCLA municipal landfills (EPA, 1993b); data collection and preparation of RI/FS for CERCLA municipal landfill sites (EPA, 1991 and 1995); application of the CERCLA municipal landfill presumptive remedy approach to military landfills including those that contain radioactive wastes (EPA, 1996b); reuse of CERCLA municipal landfill sites (EPA, 1999); and other aspects of the presumptive remedy approach to CERCLA municipal landfill sites (EPA, 1992, 1993a, and 1997c). Copies of these guidance documents are included as Appendix A to this FS.

Areas 1 and 2 are part of larger areas previously used for solid waste landfill disposal as part of historic operations at the West Lake Landfill. As Areas 1 and 2 are part of a solid waste landfill, they meet the primary criteria for use of EPA's presumptive remedy for CERCLA Municipal Landfill sites. Areas 1 and 2 contain municipal solid waste and construction and demolition debris that are intermixed with soil that was used for daily, intermediate, and final cover. Some of the soil used for cover material contained radionuclides. Consequently, the volume of waste materials (municipal solid waste, construction and demolition debris, and radiologically-impacted soil) represents a large volume or relatively low concentration waste thereby meeting the criteria established by EPA in the National Contingency Plan and the Presumptive Remedy Guidance for CERCLA Municipal Landfill sites for use of containment remedies. The overall volume and heterogeneity of the waste materials in Areas 1 and 2 combined with their contiguity with other areas of solid waste disposal at the West Lake Landfill, make treatment of these wastes impractical and therefore use of containment technologies is appropriate for OU-1.

Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris and other, non-impacted soil materials. Consequently, excavation of the radiologically impacted materials for possible ex situ treatment techniques or possible offsite disposal is impracticable. Due to the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix, in situ treatment techniques involving subsurface delivery of reagents or other substances to immobilize,

react with, or otherwise treat the radionuclide occurrences are not practicable. Due to the presence of the radionuclide materials within the overall combustible matrix of solid waste, the presence of potentially explosive levels of landfill (methane) gas, the overall low silica content of the refuse and lack of a continuous matrix for heating, application of in situ thermal treatment techniques is impracticable. Therefore, containment technologies and use of the presumptive remedy approach for municipal landfills is appropriate for OU-1.

EPA expects to use presumptive remedies at all appropriate sites except under unusual site-specific circumstances. The presence of radionuclides in a municipal landfill was not specifically addressed by EPA in the development of the presumptive remedy for CERCLA municipal landfill sites; however, EPA did address the presence of low level radionuclides in landfills as part of the development of the presumptive remedy approach for CERCLA military landfill sites. EPA has established that the presumptive remedy approach for CERCLA municipal landfill sites should also be used for appropriate military landfills (EPA, 1996). EPA has indicated that although waste types may differ between municipal and military landfills, these differences do not preclude the use of source containment as the primary remedy at appropriate military landfills, including those that contain low-level radioactive wastes (EPA, 1996). In addition, EPA has used the containment presumptive remedy at other CERCLA municipal landfill sites that contained radionuclides (EPA, 1994). Therefore, the presence of radionuclides does not negate use of the CERCLA municipal landfill presumptive remedy at the West Lake Landfill.

The presumptive remedy guidance requires the EPA (or State) site manager to make the initial decision of whether a particular municipal landfill site is suitable for the presumptive remedy. EPA's Remedial Project Manager (RPM) has indicated that use of the presumptive remedy for CERCLA municipal landfills should be considered for use in the development and evaluation of potential remedial alternatives for the West Lake Landfill.

Based upon their experiences at numerous CERCLA municipal landfill sites and as a result of the initiatives undertaken as part of the Superfund Accelerated Cleanup Model, EPA has initiated use of and developed presumptive remedies for specific types of sites, contaminants, or both, including CERCLA municipal landfill sites. The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected groundwater at the perimeter of the landfill, and/or upgradient groundwater that are causing saturation of the landfill mass may be implemented as part of the presumptive remedy.

Based upon their experience, EPA has identified the following components for consideration in applying the presumptive remedy approach for source area containment at CERCLA municipal landfills:

- Landfill cap;
- Source area groundwater control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment; and/or
- Institutional controls to supplement engineering controls.

Of these, the landfill cap, landfill gas collection and treatment and institutional control actions are considered applicable to Areas 1 and 2.

Construction of an upgraded landfill cap would achieve the following objectives:

- Prevent direct contact with landfill contents and exposure to radiation;
- Minimize infiltration and any resulting contaminant leaching to groundwater;
- Control surface water runoff and erosion and decrease the potential for erosion and subsequent transport of radiologically impacted materials; and
- Control radon and landfill gas emissions.

Therefore, implementation of an upgraded landfill cap, consistent with the presumptive remedy approach, is well suited to the waste materials and site conditions in OU-1.

As there is no plume of groundwater contamination associated with Areas 1 and 2, source area groundwater control is not applicable or required for Areas 1 and 2. With the possible exception of the seep located in the southwestern portion of Area 2, no leachate discharge has been identified from Areas 1 and 2. Therefore, leachate collection and treatment is not a required component of potential remedial actions for OU-1.

Based on the results of the radon monitoring conducted during the RI, collection or control of radon gas is not considered necessary. Radon testing performed during the RI indicated that the overall average radon emission from Areas 1 and 2 is close to the EPA standard of 20 pCi/m^2s. Installation of an upgraded landfill cover should result in a reduction in radon emissions.

Methane gas measurements were performed as part of the RI field investigations. During the RI, methane levels ranging from less than 1% to as much as 45% were observed in the various boreholes drilled for the RI. The highest levels of methane were observed in boreholes drilled in Area 1. Lower levels of methane were observed in Area 2; however, methane concentrations greater than 5% methane concentration by volume (the lower explosive limit or LEL for methane) were observed in both Area 1 and Area 2. Methane

gas generation and accumulation has been observed in other areas of the West Lake Landfill. The active portion of the West Lake Landfill has a methane gas collection and treatment system. There is a continuing potential for methane gas accumulations within Area 1 or 2 as a result of waste materials disposed within or adjacent to Areas 1 and 2 and therefore methane gas, monitoring, collection and/or treatment may need to be considered potential components of any remedial actions that may be taken for OU-1.

Institutional and access controls have previously been implemented for the West Lake Landfill overall and Areas 1 and 2. These are discussed under the No Action (L1) and Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring (L2) alternatives in Sections 4.4.4.1.1 and 4.4.4.1.2 below. Some of the existing institutional and access controls reference the consent order for the RI/FS, which will not be the operative remediation document once the remedy implementation phase begins. Accordingly, additional or revised institutional controls may be determined to be necessary to restrict land uses or site development that could result in changes in potential exposure to radionuclides or other constituents contained in the radiologically-impacted materials or other wastes at the landfill. Additional institutional controls may also be necessary to protect the integrity of any remedial actions implemented at the Site. These institutional and access controls, along with any future additions to the existing institutional and access controls, will also serve to prevent future land uses that could potentially disrupt or otherwise affect the integrity of any remedial actions that may be taken at the Site.

As discussed above, the potential exposure scenarios, possible hazards associated with OU-1, and the RAOs for OU-1 are addressed by the various remedy components associated with EPA's presumptive remedy for CERCLA municipal landfill Sites. The presence of radionuclides does not restrict or otherwise affect the applicability of the presumptive remedy approach to OU-1. Therefore, this FS report, in particular the development of remedial alternatives for OU-1, has been performed consistent with the approach set forth in EPA's presumptive remedy guidance (Appendix A).

4.4.3 Remediation of "Hot Spots"

EPA's guidance for presumptive remedies at CERCLA municipal landfill sites also describes issues to be addressed related to the characterization and possible treatment of "hot spots". Hot spots consist of highly toxic and/or highly mobile material that may present a potential principal threat to human health or the environment. This section presents a summary of the evaluation of potential "hot spot" occurrences and possible "hot spot" remediation at the West Lake Landfill. A more detailed evaluation is presented in Appendix B.

Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. A hot spot should be

large enough that its remediation would significantly reduce the risk posed by the overall site, but small enough that it is reasonable to consider removal or treatment.

EPA guidance identifies four questions to be addressed to determine whether characterization and/or treatment of hot spots are warranted. All four of these questions must be answered in the affirmative to support a decision to characterize and treat hot spots. These four questions are as follows:

- Does evidence exist to indicate the presence and approximate location of waste?
- Is the hot spot known to be principal threat waste?
- Is the waste in a discrete accessible part of the landfill?
- Is the hot spot known to be large enough that its remediation will significantly reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

With respect to the first question, reliable historic information regarding the location of the radionuclide materials does not exist. Surveys and sampling conducted as part of the RI have identified the general locations of the occurrences of the radiologically impacted materials within Areas 1 and 2. Results of the RI investigations indicate that the radiologically impacted soil material is dispersed both laterally and vertically throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and unimpacted soil cover material. Therefore, the exact location, boundaries and extent of the radiologically impacted materials cannot be precisely located and can only be approximately estimated, and the answer to the first question is no.

As to the second question, principal threat wastes addressed by the presumptive remedy guidance for which hot spot remediation is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile material. Occurrences of radiologically impacted materials at the West Lake Landfill are present in soil material, not liquids. Variations in the levels of radionuclides do occur and a few areas with higher levels of radionuclides (e.g., near soil borings WL-209, WL-210, WL-216, and WL-234) have been identified. The properties of radionuclides and the presence of the radionuclides in soil material results in the radionuclide occurrences at the West Lake Landfill being generally immobile, and do not qualify as principal threat wastes as defined in the presumptive remedy guidance.

As far as the third question is concerned, the radionuclides are not present in a discrete area, unit, or zone of the landfill. The radiologically impacted materials are present in soil material contained within the overall matrix of municipal refuse, construction and demolition debris and unimpacted soil, making retrieval of the impacted materials impracticable.

With respect to the fourth question, removal of the majority of the radioactively impacted materials would require excavation of over 250,000 cubic yards of soil and refuse which exceeds the 100,000 cubic yards threshold value identified in the guidance. Excavation of a smaller volume of radioactively impacted material would not significantly reduce the threat posed by the overall site beyond the protections afforded by the presumptive remedy. Therefore, the answer to the fourth question is no.

Based upon the evaluation of the four factors identified by EPA, implementation of "hot spot" removal as part of the remedial actions that may be undertaken for OU-1 at the West Lake Landfill does not meet the criteria established in the presumptive remedy guidance.

Although there are no areas within OU-1 that meet EPA's "hot spot" criteria, limited excavation and offsite disposal of the more accessible portions of the landfill material containing relatively higher concentration of radiologically impacted soils could offer some limited advantage in the event that institutional and engineering controls fail. Accordingly, excavation of a portion of radiologically impacted materials in OU-1 will be retained as a potential remedial alternative during the development of potential remedial alternatives for OU-1 and will be analyzed using the nine criteria specified by the NCP to provide assurance that application of the presumptive remedy approach is appropriate.

4.4.4 Remedial Alternatives for OU-1

Remedial alternatives were developed for OU-1 of the West Lake Landfill based upon EPA's presumptive remedy approach to CERCLA municipal landfills, the technologies and representative process options retained by the screening and evaluation discussed in Sections 4.2 and 4.3 and the potential RAOs for OU-1 (Section 3.2). Remedial alternatives were developed for containment of the wastes (landfill alternatives) and to address radiologically impacted soil on the Buffer Zone/Crossroad property (former Ford property).

<u>Areas 1 and 2 Landfill Alternatives</u>

- Alternative L1 – No Action
- Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring
- Alternative L3 – Soil cover to address gamma exposure and erosion potential
- Alternative L4 –Regrading of Areas 1 and 2 (minimum slope of 2%) and installation of a Subtitle D cover system

- Alternative L5 – Regrading of Areas 1 and 2 (minimum slope of 5%) and installation of a Subtitle D cover system

- Alternative L6 – Excavation of material with higher levels of radioactivity from Area 2 and regrading and installation of a Subtitle D cover system

Historic erosion of the landfill berm along the north side of Area 2 resulted in deposition of radiologically impacted soil on the surface of the Buffer Zone and Crossroad property (formerly termed the Ford property). The following remedial alternatives for the soil in this area will be evaluated as part of the development of potential remedial alternatives for West Lake Landfill OU-1:

Buffer Zone / Crossroad Property (Ford property) Alternatives

- Alternative F1 – No Action

- Alternative F2 – Institutional and Access Controls

- Alternative F3 – Capping and Institutional and Access Controls

- Alternative F4 – Soil Excavation and Consolidation in Area 2

The following sections describe each of the alternatives. Additional information is provided in Section 5 as part of the evaluation of each alternative against the NCP criteria.

There are various components of all of the remedies described above that either have already been implemented at the Site (e.g., access and institutional controls) or that are components of all of the alternatives (e.g., groundwater monitoring). The various remedy components that are common to all of the alternatives are described as part of the No Action (Alternative L1) or the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (Alternative L2) alternatives.

As under all of the alternatives described above, waste materials will remain on site, OU-1 is subject to ongoing review by EPA to assess the protectiveness and the effectiveness of the remedial actions that may be implemented at the Site. By law, these reviews must be performed at a minimum of every five years and hence have come to be termed “Five Year Reviews”. EPA has established guidance regarding the content and format of Five-Year Reviews (EPA, 2001) that details the specific evaluations that must be performed in a Five Year Review to assess the ongoing protectiveness of a remedy performed pursuant to CERCLA. A description of the Five Year Review process and the estimated costs associated with such reviews is included as part of the No Action alternative and is carried forward as part of all of the remedial alternatives being considered for OU-1.

The detailed description and conceptual design of each of the alternatives described below was based upon the results of the RI (EMSI, 2000) and the BRA (Auxier & Associates, 2000). The detailed descriptions and conceptual designs included in this section are FS-level evaluations that provide an adequate basis for evaluation of alternatives and are not intended as final descriptions or designs for any remedial action that may be selected by EPA. Additional evaluations and development of more detailed designs for any remedial action that may be selected by EPA will be conducted as part of any remedial design activities.

4.4.4.1 Area 1 and 2 Landfill Alternatives

Six potential remedial alternatives have been identified for the portions of the West Lake Landfill that contain radiological Areas 1 and 2. These six alternatives are described below.

4.4.4.1.1 Alternative L1 – No Action

Alternative 1 (No Action) is included as required by the NCP to serve as a baseline for comparison of the other alternatives. Under this alternative, no engineering measures will be implemented to reduce potential exposures or control potential migration from Areas 1 and 2. Similarly, no additional institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to Areas 1 and 2. No monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions at Areas 1 and 2 or to contaminant levels or occurrences.

As previously discussed (Section 4.3.1), institutional controls are measures that preclude or minimize public exposure by limiting use of contaminated areas. Under this alternative, the existing institutional controls at the Site would remain in effect but no onsite engineered measures would be implemented.

The existing institutional controls consist of a covenant implemented and recorded in June 1997 against the deeds for the entire landfill prohibiting residential use and groundwater use. An additional covenant was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The covenants grant EPA, the MDNR, and the owners the right to enforce their restrictions and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA. Therefore, the existing institutional controls will remain in effect as part of the No Action alternative. Copies of these land use covenants are included in Appendix C to this report. Implementation of these institutional controls requires ongoing monitoring, maintenance and enforcement to be effective.

Under the No Action Alternative, the existing institutional controls along with the existing landfill fencing would continue to control and restrict access to or inappropriate development of Areas 1 and 2. Although the existing institutional and access controls would continue in place to control current and future use of the landfill area and of Areas 1 and 2 in particular, for purposes of the No Action alternative, it is assumed that monitoring, maintenance and enforcement of the existing institutional controls will not be performed. Without monitoring, maintenance and enforcement, the existing institutional and access controls would not be effective at limiting exposure.

As under the No Action alternative, and indeed for all of the alternatives being evaluated for OU-1, waste materials will remain on site, the No Action and other alternatives are subject to ongoing Five Year Reviews by EPA as required by Section 121 of CERCLA and the NCP. The specific questions to be address by each Five Year Review include the following:

1. Is the remedy functioning as intended by the decision documents?

2. Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

3. Has any other information come to light that could call into question the protectiveness of the remedy?

EPA or the State, with or without assistance of one of their contractors, will perform a Five Year Review at a minimum of every five years after completion of the Record of Decision for the Site or, if determined by EPA to be necessary, at more frequent intervals.

4.4.4.1.2 Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

Under Alternative L2, the existing landfill cover in Areas 1 and 2 would be inspected, repaired as necessary and maintained as part of the overall maintenance of the West Lake Landfill in conjunction with ongoing operations at the landfill. Maintenance of the landfill cover would include regular inspection and repair, as necessary, of the existing landfill cover over Areas 1 and 2. Inspection, maintenance and repair would include brush-hogging adjacent to fences to remove vegetation that would affect the integrity of the fence, repair and replacement of the fence as necessary, repair of erosional channels, elimination of depressions and areas of ponded water through placement of additional soil to establish or maintain vegetative cover.

Based on a visual inspection, approximately 20% of the surface of Areas 1 and 2 do not currently contain sufficient vegetative cover to prevent or reduce the potential for windblown dust, erosion and infiltration. Therefore, it is assumed for purposes of the feasibility study that approximately 20% of the existing landfill cover over Areas 1 and 2

(total area of 45.2 acres) will require initial repair in the form of placement of additional soil and re-vegetation to eliminate ponding in low areas or fill, regrade and re-cover areas where the cover has previously been eroded. For purposes of estimating the costs of future maintenance activities, it is assumed that approximately one acre of the total area will require repair and reseeding every five years.

Besides the activities associated with operation of the landfill, portions of the West Lake Landfill property are currently used for other industrial activities including for example a concrete batch plant, asphalt plant, and outdoor storage of roll-off containers. Additional uses anticipated in the near future include use of a portion of the Site for a solid waste transfer facility. Currently, the anticipated future use of the property is continued use for waste management facilities (solid waste and/or construction and demolition waste disposal, waste transfer station, outdoor storage of roll-off containers, etc.) and industrial facilities (concrete and asphalt plants). Potential future uses of the West Lake Landfill Site that can reasonably be expected to occur after completion of landfilling activities and construction of remedial actions include continued commercial/industrial uses such as the concrete/asphalt plants, additional commercial/industrial uses such as the waste transfer station and outdoor storage, and/or maintenance of private open space. Although not currently anticipated, other possible future uses could include additional commercial facilities possibly including office space and associated parking or additional outdoor storage uses or possibly recreational facilities (ball fields, golf course, etc.).

Future use of Areas 1 and 2 could result in exposure to radionuclide or non-radionuclide constituents, could result in enhance migration of these constituents, and could impact the effectiveness of the existing or future engineered controls that may be implemented at the Site. As noted in Section 4.3.1, above, certain types of land uses could potentially result in exposure to waste materials or hazardous constituents, could result in dispersal or increased migration of such constituents or could affect the stability and integrity of the waste materials and existing engineered barriers.

To address potentially unacceptable land use, the use restrictions or institutional controls objectives described below would apply to all cap alternatives. These restrictions must be maintained until the remaining hazardous substances at the Site are sampled at levels allowing for unlimited use and unrestricted exposure. These use restrictions do not apply to activities related to the implementation, maintenance, monitoring or repair of the remedy.

These use restrictions should apply within the boundary of the cover system(s) for Area 1 and Area 2, including all bordering buffer areas (OU 1 Area).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Prevent development and use for industrial or commercial purposes, such as manufacturing, offices, storage units, parking lots or other facilities, that are incompatible with the function or maintenance of the landfill cover.

3. Prevent construction activities involving drilling, boring, digging, or other use of heavy equipment that could disturb vegetation, disrupt grading or drainage patterns, cause erosion or otherwise compromise the integrity of the landfill cover, or manage these activities such that any damage to the cover is avoided or repaired.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

The use restrictions for adjacent disposal areas will be identified under the West Lake Landfill OU 2 Feasibility Study or as part of implementation of post-closure regulations for the permitted portions of the landfill. Coordination across operable units will ensure that use restrictions are complementary.

The following use restrictions would apply to the non-disposal areas of the West Lake Landfill site.

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

At the West Lake Landfill Site, the affected properties are privately owned and the use restrictions must be maintained for a long period of time. Therefore, proprietary controls should be considered because they generally run with the land and are enforceable. The primary examples of proprietary controls, covenants and easements, are based in real property law and generally create legal property interests. This involves placing a legal instrument in the chain of title of the property. A property interest may be conveyed from the property owner (grantor) to a second party (grantee) for the purpose of

restricting land or resource use. These types of controls can be binding on subsequent purchasers of property giving them a measure of long-term reliability.

Covenants under common law are typically promises to do something (affirmative) or not to do something (negative) with regard to the land. In case of a breach of the covenant, contract law usually applies. This means that the available remedies in case of a breach of the covenant would generally be limited to monetary damages.

Restrictive covenants may be an effective tool for implementing and enforcing the use restrictions established as part of the remedy for the West Lake Landfill Site. Easements, allowing the easement holder to enter or use property for a stated purpose, could be useful for adjacent property, e.g., the Crossroad property, to secure access rights for any long-term monitoring or maintenance needs.

The institutional control component (Appendix E) of the MDNR CALM draft regulations consists primarily of a restrictive covenant with an easement provision that allows MDNR access to a site for the duration of the restrictive covenant for the purpose of conducting periodic inspections. The CALM Appendix E language provides a useful format for implementing use restrictions at the West Lake Landfill site, including the requirement that a property owner sign and record the restrictive covenant with the Recorder's Office in the county in which the property is located.

In addition to the above proprietary controls, the MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 C.S.R. 23-3.010) prohibits the placement of a well within 300 feet of a landfill. These rules should provide an additional layer of protection against the placement of wells on or near the West Lake Landfill.

Also, the West Lake Landfill site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Uncontrolled Sites Registry). The Registry is maintained by the MDNR pursuant to the Missouri Hazardous Waste Management Law, Mo.Rev.Stat. Section 260.440. Sites listed on the Registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property.

The remedial design Work Plan will contain an institutional control design and implementation plan specifying the institutional controls and identifying the steps necessary to implement proprietary controls. At a minimum, the controls will provide detailed descriptions of the types and locations of the residual contaminants, the parties involved, provisions for third party enforcement, the parties' rights, the resource/use restrictions, language to assure that the institutional controls are binding on subsequent purchasers, and specific notice and approval requirements for modifying or terminating a control. Title documentation also generally will be required.

The Operation and Maintenance (O&M) Plan will contain procedures for surveillance, monitoring and maintenance of the institutional controls. The O&M Plan will provide for notice to EPA and/or the state of any institutional control violations, planned or actual land use changes, and any planned or actual transfers, sales or leases of property subject to the use restrictions.

Based on the above considerations, proprietary controls consisting of deed restrictions, environmental covenants, and other land use restrictions that "run with the land" are preferred institutional control mechanisms for the West Lake Landfill Site to supplement the Well Construction Code and Uncontrolled Sites Registry use prohibitions. Existing proprietary controls in place for OU-1 of the West Lake Landfill Site consist of a deed covenant implemented and recorded in June 1997 in the chain of title for the entire landfill. This covenant runs with the land and against current and future property owners, and prohibits residential use and groundwater use of the entirety of the West Lake Landfill site. An additional deed covenant was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2 of the OU-1 portion of the landfill. These covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The covenants grant EPA, the MDNR, and the property owners the right to enforce the use restrictions, and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA.

These 1997 and 1998 deed covenant institutional controls will remain operative for any remedial alternative selected for the Site. Copies of these land use covenants are included in Appendix C to this report. Implementation of these institutional controls require ongoing monitoring, maintenance and enforcement to be effective.

Another proprietary institutional control is in place at Areas 1 and 2 of OU-1. Construction work and commercial and industrial uses are precluded on Areas 1 and 2 pursuant to a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc. (the owner of record of the parcels containing Areas 1 and 2) prohibiting the placement of buildings and restricting installation of underground utilities, pipes and/or excavation in these areas. These land use covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The land use covenants grant EPA, the MDNR, and any current property owners the right to enforce their restrictions and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA. Copies of these land use covenants are included in Appendix C.

The intended future use of Areas 1 and 2 is as private open space. Review of the existing institutional controls indicates that although structures cannot be built and excavation cannot be performed in Areas 1 and 2, a potential exists for future use of Areas 1 and 2 in conjunction with allowable uses in other portions of the landfill area. For example, construction of office buildings or other commercial or industrial structures could be performed in areas adjacent to Areas 1 and 2 in the future. As part of this type of

development, there may be an expectation of using Areas 1 and 2 for ancillary uses such as landscaping, parking lots, or open storage.

Additional institutional controls must be implemented as necessary to further limit future uses and to insure that the remedy implemented at the Site remains protective of human health and the environment and that possible future uses do not impact the effectiveness or integrity of the remedial actions. As part of this alternative, additional institutional controls in the form of additional restrictive covenants would be implemented to prevent or control potential future uses of Areas 1 and 2 not currently expressly restricted. Under this alternative, the current property owners will be required to record additional deed restrictions or proscriptive covenants in the property chain of title to prevent future use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. In addition, proscriptive deed restrictions will be required providing that any future construction on the property must also repair any excavations such that the integrity of the landfill cover or other remedy components is maintained, supply continued access to and allowance for maintenance of the landfill cover, runon and runoff control structures, landfill gas collection and treatment systems, if any, and groundwater monitoring wells, and landfill gas monitoring points.

Although access to the entire West Lake Landfill property is controlled by a perimeter fence, access to Areas 1 and 2 within the West Lake site is currently not controlled by fencing. To restrict access to Areas 1 and 2, additional fencing would be installed along those portions of the boundaries of Areas 1 and 2 that are not currently fenced (generally the internal boundaries of Areas 1 and 2).

Because of the potential for radon, as well as methane gas, accumulation in any structures that may be built on the landfill in the vicinity of Areas 1 and 2 or elsewhere on the landfill, an additional land use covenant may need to be enacted to require testing and installation of foundation venting and/or vapor barrier systems as necessary as part of any new building construction at the site. These types of controls are commonly used in areas where soils with naturally high levels of radon exist. Implementation of foundation venting or vapor barriers is actually an engineering measure to control radon and landfill gas migration into structures. However, under this alternative, these measures would only be implemented for any new occupied structures that may be constructed in the future at the site. Therefore, their implementation will be addressed through imposition of a land use covenant on new construction at the Site.

Several construction techniques may be used to prevent radon or other vapor migration into basements or through foundation slabs to eliminate the accumulation of radon or landfill gas in indoor air. These construction techniques (EPA, 1993d) include active soil depressurization (ASD); pressurizing a building using the heating, ventilating, and air conditioning (HVAC) system; and sealing major vapor entry routes. These vapor accumulation prevention features are very effective and can be installed relatively easily and inexpensively during new building construction.

An ASD system prevents vapor entry by creating a negative-pressure zone beneath building basements or slabs. The lower air pressure in a building compared with the surrounding soil draws radon or other vapors into a building. The ASD system reverses the pressure difference, so that the sub slab (or subbasement) pressure is lower than the indoor pressure. A vapor suction pit is installed in the aggregate under the slab to create the negative-pressure zone. The sub slab pit is then connected to a vent pipe that runs from the pit to the outdoors. A suction fan is connected to the pipe outside of the building to produce the negative-pressure zone beneath the slab.

A building HVAC system may be designed and operated to reduce vapor entry and radon accumulation by building pressurization and dilution. The HVAC system can be used to produce a slightly positive air pressure inside all areas of the building. Pressurization is accomplished by drawing more outdoor air into the building than is removed. Excess air that is not removed by the exhaust system is forced out of the building through cracks and unsealed openings in the building shell, thereby preventing vapor entry through the same cracks and unsealed openings. The outdoor air also increases building ventilation and dilutes radon concentrations in vapors that may enter the building.

Vapor entry and radon accumulation may also be minimized by sealing cracks and openings in the building slab or substructure. However, it is difficult to seal every crack and penetration. Therefore, sealing vapor entry routes or constructing physical barriers as stand-alone approaches are not currently recommended (EPA, 1993d). However, sealing major vapor entry routes will help reduce radon accumulation and increase the effectiveness of the other vapor prevention techniques. For example, sealing increases the effectiveness of ASD by improving or extending the negative-pressure field beneath the slab or basement. Sealing also helps achieve building pressurization by minimizing air leakage. As an alternative to sealing the foundation of a building, a vapor barrier, consisting of an HDPE liner or other suitable low permeability material can be installed below a new building foundation to prevent upward migration of radon from the subsurface to the area adjacent to the building foundation.

Alternative L2 would also include a provision for groundwater monitoring. The general requirements for the long-term groundwater monitoring component of the selected remedy are anticipated to be described in the Record of Decision. The exact scope and requirements for the long-term groundwater monitoring component of the selected remedy will be set forth in the remedial design documents. Design and implementation of a long-term groundwater monitoring program is expected to meet the substantive requirements of the UMTRCA groundwater protection and monitoring requirements and the MDNR post-closure regulations for closed solid waste landfills.

A point of compliance for groundwater monitoring will be defined by EPA in the Record of Decision. For purposes of this FS it is anticipated to consist of those portions of the boundaries of Areas 1 and 2 that are coincident with the boundary of the West Lake Landfill. Specifically, this would include the northeastern boundary of Area 1 and the

northeastern, northern, northwestern and western boundaries of Area 2. The point of compliance used for this FS does not include the other boundaries of Areas 1 and 2 as these boundaries are located internal to and within the overall boundary of the landfill and therefore are adjacent to areas containing other landfill wastes making compliance monitoring along these boundaries impractical.

For purposes of the evaluation of potential remedial alternatives, it is assumed that 11 existing monitoring wells located in three clusters along the northern and western (presumed downgradient) boundary of Area 2 and wells PZ-114-AS and PZ-115-SS adjacent to Area 1 would be monitored (Figure 4-3). These 11 wells were selected, as they would provide both lateral and vertical coverage of groundwater conditions downgradient of Areas 1 and 2 and/or along the site boundaries. Wells S-8, I-62 and D-83 are located at the northern boundary of Area 2 and may no longer exist as a result of development of the adjacent Crossroad property. As part of this alternative, these wells will need to be replaced. As part of remedial design activities, the status of all of the wells proposed for inclusion in the long-term groundwater monitoring program will need to be assessed and any wells that are damaged or no longer exist at that time may need to be replaced as part of implementation of remedial actions at the Site consistent with the requirements of the groundwater monitoring network contained in the EPA-approved remedial design documents.

For purposes of the FS evaluation of alternatives and in particular to develop a cost estimate, it is assumed that these wells would be sampled quarterly for three years to characterize baseline conditions. After the first three years of baseline monitoring, it is assumed that the groundwater monitoring would be conducted semiannually on a biannual basis to identify any changes that may occur in the future.

For purposes of preparing this FS, it is assumed that groundwater samples will be analyzed for gross alpha and beta, uranium and radium isotopes, VOCs, and select trace metals as required by the UMTRCA groundwater protection standards and the MDNR regulations (Table 4-1). As these wells would only be sampled infrequently and the goal of the monitoring program would be to identify changes in water quality over time, not to simulate drinking water conditions, the samples would be filtered in the field and the analyses would reflect the dissolved fraction only. Filtering and performance of dissolved analyses will eliminate uncertainties and large statistical variances associated with varying levels of suspended solids entrainment in the samples. Water level data and field parameters (pH, specific conductance, turbidity and temperature) would be obtained as part of the groundwater monitoring activities.

As with any alternative, the exact number and locations of the wells to be monitored, the parameters for which they would be monitored, and the frequency at which they would be monitored would be determined as part of the remedial design activities if this alternative was selected. The description of the wells to be monitored, analyte list, and monitoring frequency presented above is intended solely to provide a basis for describing the alternative and to develop an estimated cost for this activity.

In addition to the groundwater monitoring component of this alternative, a landfill gas monitoring program would also be developed and implemented as part of the remedial actions for OU-1. Similar to the groundwater monitoring component, the need for and scope of the landfill gas monitoring program will be specified by EPA in the Record of Decision. The exact number and locations of gas monitoring points and measurement frequency will be determined in EPA-approved remedial design documents for OU-1. For purposes of this FS report, it has been assumed that approximately 12 gas monitoring probes will be installed along those portions of Areas 1 and 2 that are coincident with the boundaries of the West Lake Landfill property, specifically the northeastern boundary of Area 1 and the northeastern, northern, northwestern and western boundaries of Area 2. Methane gas and radon monitoring will be performed on a quarterly basis for three years to characterize baseline conditions. After the first three years of baseline monitoring, it is assumed that the landfill gas monitoring would be conducted semiannually on a biannual basis to identify any changes that may occur in the future. In the event that landfill gas (methane) or radon is detected along the site boundaries at levels above regulatory thresholds (e.g., 5% of the LEL for methane), a contingent corrective action of gas extraction and treatment could be implemented.

Alternative L2 would also include performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.1.3 Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

Alternative L3 would consist of placement of an 30-inch thick soil cover over Areas 1 and 2 to reduce the potential gamma exposure to workers that may enter these areas in the future. Placement of additional soil cover would also reduce the potential for windblown or water erosion of surface soil containing radionuclides.

Auxier & Associates has calculated the current gamma exposure rates for Areas 1 and 2 to be approximately 1.5 rems/year (1500 mrems/year). This calculation is based on use of the 95% upper confidence interval for the mean values for the activities of the radionuclides present in Areas 1 and 2. Therefore, the current condition at the landfill would meet the Missouri occupational exposure standards for protection against ionizing radiation in a controlled area (5 rems or 5,000 millirems [mrems]/year). As discussed above, access to the landfill property by the general public is controlled; however, access to Areas 1 and 2 is not currently controlled. In addition, although based on use of the 95% upper confidence interval, the levels of radiation in Areas 1 and 2 would meet the Missouri occupational exposure standards, there are some smaller areas within Areas 1 and 2 in which these standards could be exceeded.

The BRA (Auxier & Associates, 2000) also examined potential risks that may be posed by Areas 1 and 2, including risks to groundskeepers, possible trespassers, or others not

directly employed at the landfill that might enter Areas 1 and 2. The risk assessment determined that due to the potential frequency and duration of possible exposure, the greatest potential risk would occur for a potential future groundskeeper. The potential frequency and duration of possible exposure for a groundskeeper were greater than those anticipated to occur for an occasional trespasser and therefore, the potential risks for the groundskeeper exposure scenario were evaluated. A potential future groundskeeper is anticipated to be present in Areas 1 and 2 approximately 8 hours per day, one day per week for 26 weeks per year for a total duration of 208 hours/year (Auxier & Associates, 2000). The calculated risks associated with this exposure are approximately 1500 mrem/yr or a potential carcinogenic risk of approximately 6×10^{-5} and 2×10^{-4} for Areas 1 and 2 respectively. These levels are less than the Missouri maximum permissible limit for exposure to ionizing radiation of 5 rems (5,000 mrem) per year, which as discussed in Section 3.1.1.3 are not applicable, but may potentially be relevant and appropriate to OU-1. The calculated risk levels for a potential future groundskeeper are also generally within or slightly exceed EPA's accepted risk range of 10^{-4} to 10^{-6}. Although no additional cover would be necessary to meet the Missouri standards, placement of approximately 18 inches of additional soil over the top of Areas 1 and 2 would reduce the gamma exposure levels to 15 mrem/year (Figure 4-4), which is within the accepted risk range used by EPA of 10^{-4} to10^{-6}.

A potential future worker involved in outdoor storage or other activities on the surface of Area 1 and 2 that would be ancillary to commercial or industrial uses on the landfill adjacent to Areas 1 and 2 could theoretically be exposed to the radiologically-impacted materials 8 hours per day, 5 days per week, 50 weeks per year. The calculated radiation exposure under this scenario is approximately 15,000 mrem per year which is approximately three times greater than the Missouri standard, which although not considered to be applicable, may be relevant and appropriate to OU-1 (see discussion in Section 3.1.1.3). This exposure was calculated to result in excess lifetime cancer risks of 1×10^{-4} and 4×10^{-4} for Areas 1 and 2, respectively, which are generally within or slightly exceed EPA's accepted risk range. Installation of a 4 inch thick soil cover would reduce this potential exposure to meet the Missouri standard of 5,000 mrems per year (Figure 4-5). Installation of a 30-inch thick soil cover over the top of Areas 1 and 2 would reduce this potential exposure to approximately 15 mrems per year (Figure 4-5), which is approximately 3000 times less than the Missouri standard and within the accepted risk range used by EPA of 10^{-4} to 10^{-6}.

For purposes of the development of this alternative, it was assumed that approximately 30 inches of additional soil would be placed over Areas 1 and 2. The areas over which the additional soil cover would be placed are shown on Figure 4-6 and total approximately 45.2 acres. Based on the areas shown on this figure and assuming an 30-inch finished thickness for the additional soil cover, approximately 171,000 in-place yards of soil material will be required for this alternative. Assuming a 25% compaction rate (Caterpillar, 1996), a total of 228,000 loose cubic yards (LCY) of additional soil material would need to be brought on site. This additional soil material would be obtained from

commercial sources in the St. Louis area and trucked to the Site. The soil cover would be seeded, fertilized, and mulched to establish vegetation.

After construction, the soil cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Alternative L3 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes, they are part of the overall landfill perimeter and therefore regrading these areas would require regrading slopes outside of Areas 1 and 2, and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and

existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water flow, if any, that may occur as a result from placement of additional soil cover on Areas 1 and 2 would be included in the scope of Alternative L3.

In addition to placement of the additional soil cover, Alternative L3 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above (Section 4.4.4.1.2). Institutional controls will not only limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also will restrict activities that could potentially affect the integrity of the soil cover to be installed under Alternative L3

The groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L3. Alternative L3 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of any soil cover, institutional controls, and inspection and maintenance requirements will be conducted as part of the remedial design phase. Information regarding the design basis and materials provided above is intended solely for describing the alternative and developing estimated costs as part of the FS.

4.4.4.1.4 Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System

Alternative L4 would consist of placing additional soil or inert fill material (non-putrescible construction and demolition debris such as concrete or asphalt rubble) or soil over Areas 1 and 2 to increase the final grades to achieve a minimum slope angle of 2%. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 2%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary. Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. Design and construction of the landfill cover would include a rubble/rock layer to minimize bio-intrusion and erosion potential and increase the longevity of the landfill cover.

While the MDNR landfill regulations refer to a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)], during conversations between Mr. Evan Randall of Spencer Fane Britt & Browne, LLP and Mr. Frank Dolan of MDNR, Mr. Dolan indicated that the purpose of the minimum slope of 5% is to address potential settlement of a landfill over time and the creation of depressions in the landfill surface that would collect precipitation

runoff and become areas of increased infiltration of precipitation. Mr. Dolan further indicated that MDNR previously required a 2% slope on the surface but, based on "common observations" of settlement of closed landfills MDNR subsequently determined that this slope angle was not great enough to prevent ponding of water due to differential settlement. Mr. Dolan referenced an article by Dean K. Wall and Chris Zeiss in the Journal of Environmental Engineering (Vol. 121, No. 3, March 1995) as the only formal document that MDNR used to select the 5% slope. In this article, the authors state that the process of differential settlement will take place within a 20 to 30 year period after a landfill is closed. The article does not address what the slope angle should be on the final surface of the landfill after settling.

Based on the fact that landfilling of the portions of the West Lake Landfill in which Areas 1 and 2 are located was completed approximately 30 years ago, differential settlement is not a concern because the majority of the differential settlement and compaction of the refuse has already occurred. Therefore, a 2% minimum slope should be sufficient to promote drainage and reduce infiltration of precipitation. As the 5% minimum final slope requirement was intended to be applied to active landfills and not retroactively applied to closed landfills, and given that the 2% slope is considered sufficient to promote drainage thereby reducing infiltration, the 5% final grade is not necessarily considered to be an appropriate requirement. Furthermore, use of a 2% slope should result in a lower potential for erosion increasing the life of the cover and overall longevity of the remedy compared to a 5% slope which would be subject to increase erosion potential. Alternative L4 has been developed to provide for a 2% minimum grade in Areas 1 and 2.

Portions of Areas 1 and 2 that contain slopes less than 2% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% and $33^{1}/_{3}$% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 2% will be regraded through placement of additional inert fill or soil and/or by regrading (cutting and filling) the existing waste material and soil as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will also be regraded either through placement of additional fill material/soil and/or by cutting and filling of the existing material as part of this alternative. Regrading of slopes greater than 25% will be performed only in those areas where sufficient space exists between the toe of the landfill and the adjacent property.

Clean construction debris or other inert fill material or soil would be placed over the existing surface so as to achieve a 2% final grade. Figure 4-8 displays the approximate thickness of additional material that will need to be placed prior to construction of the final cover. The total volume of soil/fill material that will need to be placed to achieve the 2% final grade prior to cover construction is approximately 84,000 in-place yd^3. Allowing for compaction, approximately 112,000 LCY of soil will need to be imported to the Site. As settlement and compaction of the existing waste materials and soil may

occur in response to placement of additional fill or soil cover, the estimated volume of additional fill may need to be increased to account for compaction during placement. The increased volume of the amount of material to be imported compared to the final in-place volume will be a function of the nature of the fill material to be used, placement and compaction techniques and moisture content.

Regrading of the landfill surface to achieve final grades can also be achieved by cutting and filling the existing waste material to achieve final slopes. Portions of Area 2 which contain slopes less than 2% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 2% will be regraded by cutting and filling of the existing landfill materials to achieve the desired slopes as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will be regraded as part of this alternative.

Assuming a nearly balanced approach to the volume of cut and fill, a total of approximately 15,200 yd^3 would be cut and approximately 15,300 yd^3 would be filled in Area 1 for a net increase in total volume of approximately 100 yd^3 to be made up with additional soil or inert material. For Area 2, approximately 126,000 yd^3 would be cut and approximately 123,000 yd^3 would be filled in Area 2 with a net surplus in total volume of 3,000 yd^3 that would be used as a portion of the proposed final cover. Figure 4-9 displays the approximate thickness of material that will need to be cut and filled in Areas 1 and 2.

Alternative L4 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes and they are part of the overall landfill perimeter. Therefore, regrading these areas would require regrading slopes outside of Areas 1 and 2 and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be

imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Regardless of whether the landfill is regraded through placement of additional fill material/soil or by cutting and filling of the existing waste material and soil, a new final cover will be installed consistent with the MDNR final cover requirements for operating demolition landfills. The final cover will be a Subtitle D-equivalent cover consisting of two-ft of compacted clay soil possessing a permeability of 1×10^{-5} centimeters per second (cm/sec) or less overlain by a one-foot thick, non-compacted soil layer that will be vegetated with native grasses (vegetation layer). Although not required for a Subtitle D cover, a two-ft thick layer of rock or concrete debris will be installed immediately beneath the clay layer to restrict the potential for bio-intrusion and erosion and increase the longevity of the landfill cover.

The cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2 with two feet of rock/concrete rubble and three feet of soil. From bottom to top, the cover systems would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick erosion layer of soil capable of sustaining vegetative growth.

Assuming that the landfill is regraded through placement of additional soil/fill material, the two feet of compacted clay would have volume of approximately 182,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 93,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-10. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 243,000 loose cubic yards (LCY) of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 126,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 173,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 61,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

Assuming that the landfill is regraded by cutting and filling of the existing waste material and soil, the two feet of compacted clay would have a volume of approximately 169,000

in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 86,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-11. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 225,000 LCY of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 116,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 163,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 57,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

After construction, the landfill cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional compacted soil or vegetative layer soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water flow, if any, that may occur as a result of the cover systems described for Areas 1 and 2 would be included in the scope of Alternative L4.

In addition to regrading the landfill through placement of additional soil or inert material or alternatively by regrading of the existing waste material and soil, and installation of the cover system, this alternative would also include the additional access restriction and institutional controls. Alternative L4 incorporates the current and anticipated additional

institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L4.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L4. In addition, Alternative L4 would include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of the final grading plan and cover system, institutional controls, inspection and maintenance requirements, and design and maintenance of any associated surface water controls will be assessed as part of the remedial design phase. Information regarding the design basis, materials, and specifications provided above is intended solely for describing the alternative and developing a cost estimate as part of the FS.

4.4.4.1.5 Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System

Alternative L5 would consist of placing additional soil or inert fill material (non-putrescible construction and demolition debris such as concrete or asphalt rubble) over Areas 1 and 2 to increase the final grades to achieve a minimum slope angle of 5% specified in the MDNR regulations (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)) for final cover for operating municipal solid waste or construction and demolition landfills. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 5%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary. Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. Design and construction of the landfill cover would include a rubble/rock layer to minimize bio-intrusion and erosion potential.

Portions of Areas 1 and 2 which contain slopes less than 5% are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% and $33^{1}/_{3}$% are also displayed on Figure 4-7. Portions of Areas 1 and 2 possessing slopes less than 5% will be regraded through placement of additional inert fill or soil and/or by regrading (cutting and filling) the existing waste material and soil as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will also be regraded either through placement of additional fill material/soil and/or by cutting and filling of the existing material as part of

this alternative. Regrading of slopes greater than 25% will be performed only in those areas where sufficient space exists between the toe of the landfill and the adjacent property.

Clean construction debris or other inert fill material or soil would be placed over the existing surface so as to achieve a 5% final grade. Figure 4-12 displays the approximate thickness of additional material that will need to be placed prior to construction of the final cover. The total volume of soil/fill material that will need to be placed to achieve the 5% final grade prior to cover construction is approximately 218,000 in-place yd^3. As settlement and compaction of the existing waste materials and soil may occur, the estimated volume of additional fill needing to be placed may need to be increased to account for compaction during placement. The increased volume of the amount of material to be imported compared to the final in-place volume will be a function of the nature of the fill material to be used, placement and compaction techniques and moisture content.

Regrading of the landfill surface to achieve final grades can also be achieved by cutting and filling the existing waste material to achieve final slopes. Portions of Area 2 which contain slopes less than 5% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 5% will be regraded by cutting and filling of the existing landfill materials to achieve the desired slopes as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will be regraded as part of this alternative.

Assuming a nearly balanced approach to the volume of cut and fill, a total of approximately 17,000 yd^3 would be cut and filled in Area 1. For Area 2, approximately 115,000 yd^3 would be cut and filled in Area 2. Figure 4-13 displays the approximate thickness of material that will need to be cut and filled in Areas 1 and 2.

Alternative L5 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes and they are part of the overall landfill perimeter. Therefore, regrading these areas would require regrading slopes outside of Areas 1 and 2 and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Regardless of whether the landfill is regraded through placement of additional fill material/soil or by cutting and filling of the existing waste material and soil, a new final cover will be installed consistent with the MDNR final cover requirements for operating demolition landfills. The final cover will be a Subtitle D-equivalent cover consisting of two-ft of compacted clay soil possessing a permeability of 1×10^{-5} cm/sec or less overlain by a one-foot thick, non-compacted soil layer that will be vegetated with native grasses (vegetation layer). Although not required for a Subtitle D cover, a two-ft thick layer of rock or concrete debris will be installed immediately beneath the clay layer to restrict the potential for bio-intrusion and erosion and increase the longevity of the landfill cover.

The cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2 with two feet of rock/concrete rubble and three feet of soil. From bottom to top, the cover systems would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick erosion layer of soil capable of sustaining vegetative growth.

Assuming that the landfill is regraded through placement of additional soil/fill material, the two feet of compacted clay would have a volume of approximately 155,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 80,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-14. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 206,000 loose cubic yards (LCY) of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 107,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 148,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a

uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 52,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

Assuming that the landfill is regraded by cutting and filling of the existing waste material and soil, the two feet of compacted clay would have volume of approximately 245,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 125,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-15. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 327,000 LCY of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 169,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 234,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 82,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

After construction, the landfill cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional compacted soil or vegetative layer soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water

flow, if any, that may occur as a result of the cover systems described for Areas 1 and 2 would be included in the scope of Alternative L5.

In addition to regrading the landfill through placement of additional soil or inert material or alternatively by regrading of the existing waste material and soil, and installation of the cover system, this alternative would also include the additional access restriction and institutional controls. Alternative L5 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L5.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L5. Alternative L5 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of the final grading plan and cover system, institutional controls, inspection and maintenance requirements, and design and maintenance of any associated surface water controls will be assessed as part of the remedial design phase. Information regarding the design basis, materials, and specifications provided above is intended solely for describing the alternative and developing a cost estimate as part of the FS.

4.4.4.1.6 Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System

Although as discussed elsewhere (Section 4.4.3 and Appendix B), the radiological materials in Areas 1 and 2 do not meet the criteria for “hot spot” removal as established in EPA’s “Presumptive Remedy for CERCLA Municipal Landfill Sites” guidance (EPA, 1993b), removal of a portion of the radiologically impacted materials within Areas 1 and/or 2 has been retained as a potential remedial alternative for OU-1. The evaluations presented in Section 4.4.3 and Appendix B support the conclusion that there are no discrete, accessible principal threat wastes meeting the hot spot criteria as described in EPA’s presumptive remedy guidance. While there are no “hot spots”, based on the long-term hazard associated with radionuclides, this FS includes an alternative that examines possible excavation of some accessible portion(s) of the landfill material that may contain relatively higher concentrations of radiologically contaminated material.

Alternative L6 consists of excavation of that portion of the radiologically impacted materials in Area 2 that contain levels of radioactivity that are higher than those found in other portions of Area 2 along with the installation of an upgraded landfill cover. No specific criteria have been established or defined for identification of radiologically

impacted materials containing higher levels of radioactivity. As part of the development of this alternative, excavation of all of the identified radiologically-impacted material was initially evaluated (Appendix B). This assessment indicated that over 250,000 yd^3 of material (including 130,000 yd^3 of radiologically-impacted materials and approximately 120,000 yds^3 of overburden waste materials and soil) would have to be excavated. This amount of excavation is substantially greater than the 100,000 yd^3 or less volume identified in EPA's Presumptive Remedy for CERCLA Municipal Landfill Sites guidance (EPA, 1993b) as being reasonable to consider for removal. Therefore, this alternative looks at the possibility of removing a smaller volume (a subset) of the radiologically-impacted materials from Area 2 which contains higher levels of radionuclides found at the Site.

For purposes of developing this alternative, the activity levels of individual radionuclides and gamma levels measured in the downhole (borehole) gamma logs were reviewed to identify those materials with levels of radioactivity that were higher than those found in other portions of Area 2. The purpose of this effort was to identify a sub-area(s) within Area 2 that are substantially smaller than the entire extent of Area 2 that could be considered for excavation as part of a possible "hot spot" removal alternative.

As a starting point, the total extent of the area containing radionuclides at levels above the UMTRCA criteria for unrestricted use (40 CFR 192) was identified. Figure 4-16 displays the approximate extent of radionuclides with levels of radium or thorium above the UMTRCA standard (40 CFR 192); that is radium or thorium levels greater than or equal to background plus 5 pCi/g. The total area containing radium or thorium at levels greater than 5 pCi/g above background is estimated to be approximately 818,000 ft^2 (approximately 18.8 acres).

The criteria used to identify an area for possible "hot spot" removal were the activity levels of individual radionuclides and the levels of downhole gamma readings. Figure 4-16 displays the approximate extent of radionuclides with levels of individual radionuclides above 100 pCi/g and/or downhole gamma readings above 100,000 counts per minute (cpm). The total area containing radionuclides greater than 100 pCi/g or downhole gamma readings above 100,000 cpm is estimated to be approximately 542,000 ft^2 (approximately 12.4 acres). This area represents approximately two-thirds of the entire area containing radionuclides above background in Area 2. The extent of the area containing individual radionuclides above 100 pCi/g and/or downhole gamma readings above 100,000 cpm represents the majority of Area 2, and therefore is not significantly different from the areal extent defined based on the UMTRCA criteria. Therefore, identification of an area for potential removal of a portion of radiologically impacted materials from Area 2 will not be based on criteria of 100 pCi/g and downhole gamma readings above 100,000 cpm.

Figure 4-16 also displays the approximate extent of radionuclides with levels of individual radionuclides above 1,000 pCi/g and/or downhole gamma readings above 500,000 cpm. Two separate areas are identified on this figure; one in the vicinity of

boring WL-209 and a larger area around borings WL-210, WL-216, and WL-234. The total area containing radionuclides greater than 1,000 pCi/g or downhole gamma readings above 500,000 cpm is estimated to be approximately 190,000 ft^2 (approximately 4.4 acres). This area represents approximately one-fourth of the entire area containing radionuclides above background in Area 2. As this area represents a reasonable subset of the entire extent of Area 2, that is the identified volume is within the range that EPA defined in their presumptive remedy guidance (EPA, 1993b) as being reasonable for removal. Therefore, these criteria will be used to define the "hot spot" removal alternative.

Under this alternative, materials containing individual radionuclides with activity levels above 1,000 pCi/g or gamma readings above 500,000 cpm would be excavated. Under one scenario, all of these materials (construction and demolition debris, household and commercial refuse, radiologically impacted soil and unimpacted soil) would be shipped offsite for disposal at a licensed commercial low-level radioactive waste disposal facility. Based on characterization of the depth of radiologically impacted materials conducted during the RI (EMSI, 2000), the total thickness of the radiologically impacted materials to be removed under this alternative would be approximately 5 to 6 feet. The total in-place volume of radiologically impacted materials (soil and waste) to be removed under this alternative is estimated to be approximately 1,150,000 cubic feet (42,430 bank cubic yards [BCY]). Assuming an in-place density of approximately 1,500 lb/yd3, a total of 32,000 tons of material (soil and waste) would be excavated and hauled offsite for disposal.

Excavation of this material will result in an increase in the volume of materials. No specific information is available on the exact increase that will occur during this excavation. Typical bulking factors for soil are approximately 120% to 130% (i.e., a 20% to 30% increase in volume) [Caterpillar, 1996]. Due to expansion of the previously compacted wastes and the variability in the size and nature of materials disposed of in a municipal landfill, a greater degree of bulking is anticipated for solid waste compared to soil. Experience with excavation at the Tulalip Landfill NPL Site in Snohomish County, Washington indicated that during excavation of previously disposed solid waste, the waste materials increased in volume by a factor of two (a 200% bulking factor). Based on a bulking factor of 200%, the total volume of material (waste plus soil) to be shipped and disposed at a commercial low-level radioactive waste disposal facility in conjunction with excavation of "hot spot" material under this alternative is estimated to be approximately 85,000 yds^3.

Assuming 20 yds^3 trucks would be used to transport these materials (waste and soil) from the Site, a total of approximately 4,250 truckloads will be required to transport the excavated material offsite. If these trucks were to haul this material to a rail-loading facility and the material was placed in 100 yds^3 gondola rail cars [which can hold approximately 76 cu yds (McDaniel, et al, 1999)] for transport to a commercial disposal facility, a total of approximately 1,120 railcars would be required for transport of the excavated waste and soil material under this alternative.

As an alternative to shipping all of the excavated material (construction and demolition debris, commercial and household refuse, radiologically impacted soil, and unimpacted soil) for offsite disposal, the excavated material could be screened to separate out the soil (both impacted and unimpacted) fraction from the debris and refuse. Soil is used in landfill construction for daily, intermediate and final cover. Assuming that the amount of soil in the excavated material is typical of older solid waste landfills, the soil fraction is expected to be approximately 40 to 50%. This high percentage is due in part to the fact that only the upper portion of the landfill (the upper 5 to 6 ft) will be excavated and presuming a two foot thick final cover, results in the excavated material containing a higher percentage of soil than would be found in the landfill overall. Assuming a 40% soil fraction, the total volume of soil to be separated and disposed offsite is estimated to be approximately 17,000 yd^3. Assuming a bulking factor of 125% for soil (Caterpillar, 1996), this translates to a volume for transport and disposal of 21,250 yd^3 of soil after segregation from the refuse. A total of approximately 1,063 truck loads would be required to ship the recovered soil offsite and a total of approximately 213 train railcars would be needed to transfer the segregated soil material to a disposal facility. Assuming a density of 2,000 lb/yd^3, the total mass of soil to be shipped and disposed offsite is estimated to be 21,000 tons.

In addition to the selective excavation component described above, Alternative L6 would also include backfilling of the selective excavation with soil or inert fill material, regrading and construction of an upgraded landfill cover as described under Alternative L4 or L5; as well as the additional access restriction and institutional controls.

Alternative L6 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L6.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L6. Alternative L6 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2 Buffer Zone and Crossroad Property Alternatives

Historic erosion of the landfill surface and slope of the landfill berm resulted in deposition of radiologically impacted soil onto property formerly owned by Ford Motor Credit Co. (Ford) located adjacent to the northern portion of Area 2. Prior to 1998, Ford subdivided and sold all of its property in this area. The majority of the Ford property was sold to Crossroad Properties LLC and has been developed into the Crossroad Industrial Park. Ford retained the 1.78 acres immediately adjacent to the western portion of the northern boundary of Area 2, referred to as the Buffer Zone, the ownership of which was

subsequently acquired by Rock Road Industries, Inc. (Rock Road) on behalf of the Respondents. Prior to 1999, Crossroad had developed all of their property with the exception of Lot 2A2, a 3.58 acre parcel located immediately north of the Buffer Zone. It is the intention of the Respondents to amend the existing land use covenant so that it would also apply to the Buffer Zone as part of the implementation of the selected remedial action for OU-1.

In 1999, soil was scraped from Lot 2A2 and placed in piles on the Buffer Zone or Lot 2A1. The area subsequently became revegetated by natural processes. In 2004, it was discovered that Crossroad Lot 2A1 as well as the Buffer Zone property had been regraded, a gravel cover had been installed, and the area was being used by AAA Trailer for storage of trailers. AAA Trailer reported that the soil piles created in 1999 that had been present on Lot 2A2 and the Buffer Zone had been piled in the northeastern corner of Buffer Zone near the location of monitoring well WL-206. This area was characterized as part of the RI completed in 1998; soil sampling of this area was conducted in February 2000 after the 1999 soil grading activities by AAA Trailer; however, no additional soil sampling or other characterization activities were performed after the subsequent soil grading activities by AAA Trailer. For evaluation of remedial alternatives in this FS, it has been assumed that soil containing radionuclides at levels above those suitable for unrestricted use still remain on the Buffer Zone and Lot 2A2.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas. Under this scenario, the use restrictions will encompass the impacted area of the Buffer Zone and no additional use restrictions will be necessary to address this property. As previously discussed, radiologically-impacted soil may remain beneath portions of Lot 2A2 of the Crossroad property. Soil sampling will be undertaken to support the remedial design and evaluate the potential presence of radiologically impacted soil beneath Lot 2A2. In the event that radiologically impacted soil does remain beneath Lot 2A2 and such soil is not removed as part of the selected remedy, implementation of land use restrictions such as those described under Alternative F2 may be required for this property..

Four alternatives have been identified for the radiologically impacted soil on the Buffer Zone and Crossroad property. These alternatives are described in the following subsections.

4.4.4.2.1 Alternative F1 – No Action

Alternative F1 (No Action) is included as required by the NCP to serve as a baseline for comparison of the other alternatives. Under this alternative, no engineering measures will be implemented to reduce potential exposures to the radiologically impacted soil in

the Buffer Zone and Crossroad property. Similarly, no new institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to the Buffer Zone and Crossroad properties. Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. No long-term monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions in the Buffer Zone or Crossroad property or to contaminant levels or occurrences in this area.

Alternative F1 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

In November 1999, it was discovered that the surface of Crossroad Lot 2A1 was graded and capped with gravel by, or on the behalf of AAA Trailer. This grading and capping occurred after completion of the investigations and sampling activities performed for the RI for OU-1 had been completed. Consequently additional sampling was performed in 2000 to assess the levels of radionuclides remaining in the surface soil of Lot 2A2 and the Buffer Zone (see discussion in Section 2.2.1.3). With the exception of the thorium-230 result for a single sample, the results of the additional sampling indicated that only background levels of radionuclides or levels slightly above background remained on Lot 2A2 and the Buffer Zone. As part of this regrading, piles of soil were created and left on portions of Crossroad Lot 2A2 and the Buffer Zone.

During preparation for additional groundwater sampling performed as part of the FS activities, it was discovered that additional grading and capping had been performed. The surface of Crossroad Lot 2A2 and the Buffer Zone had been graded and capped with gravel by, or on the behalf of AAA Trailer. This additional grading activity was performed after completion of the initial and additional investigations and sampling activities performed for completion of the RI and FS for OU-1. Although AAA Trailer has reported that the most recent regrading involved pushing soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the soil piles on Lot 2A2 and the Buffer Zone observed in 1999 and 2000 no longer exist and the final disposition of these soil piles (whether they were hauled offsite or spread out beneath the gravel layer) is unknown. Consequently, the current conditions of these two parcels with respect to radionuclide occurrences above background, if any, are unknown at this time.

For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. As part of the No Action alternative, or any of the other Buffer Zone and Crossroad property alternatives, additional soil sampling will need to be performed to assess the current levels of radionuclides, if any, in surface soil on Lot 2A2 and the Buffer Zone. These data will be used to assess whether current conditions allow for unrestricted use of these parcels or whether remedial actions such as those described for alternatives F2, F3 and F4 are required. This sampling will be performed in

accordance with the MultiAgency Radiation Survey and Site Investigation Manual (MARRSIM).

4.4.4.2.2 Alternative F2 – Institutional and Access Controls

Alternative F2 would entail implementation of institutional and access controls on the Buffer Zone and Crossroad property. A full discussion of institutional controls and institutional control mechanisms appears at Sections 4.3.1 and Section 4.4.4.1.2, above. The following use restrictions would apply to the Buffer Zone and the Crossroads Property of the West Lake Landfill site under Alternative F2 (and also as discussed below F3).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Soil sampling will be undertaken to support the remedial design and confirm these assumptions. Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas within the Buffer Zone. Under this scenario, the use restrictions will encompass the impacted area of the Ford property and no additional use restrictions will be necessary to address the Buffer Zone; however, use restrictions may be required for Crossroad Lot 2A2 to prevent exposure to radiologically-impacted soil, if any, that may be present beneath this parcel and to protect the integrity of the landfill toe and cover system on the adjacent Buffer Zone.. The institutional control component (Appendix E) of the MDNR CALM draft regulations provides a useful format for implementing use restrictions at the West Lake Landfill site.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties.

Under this alternative, additional fencing would be installed as an additional access restriction around the Buffer Zone as necessary to complete the perimeter fence around this property to prevent access to this property. Specifically, approximately 900 feet of additional fencing would be installed along the northwestern and southwestern boundaries of the Buffer Zone (Figure 2-7). Signage would be installed to warn potential trespassers.

Alternative F2 would include additional soil sampling to assess the current conditions of the surface soil in Lot 2A2 and the Buffer Zone after the recent grading and capping activity performed by, or on the behalf of AAA Trailer. Alternative F2 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2.3 Alternative F3 – Capping and Institutional and Access Controls

Alternative F3 includes construction of a cap consisting of a minimum 6-inch thick gravel layer, asphalt or other form of pavement, or another form of surface preparation installed over the Crossroad property to prevent direct contact with the radiologically impacted soil. Installation of gravel or pavement over the surface of the Crossroad property is consistent with the currently intended use of the property for outdoor storage of tractor trailers. Installation of a gravel cover or pavement would prevent direct contact by workers with the radiologically impacted soil.

The radiologically-impacted soil on the Buffer Zone (assuming some still remains after the recent regrading and construction of a gravel cap performed by, or on the behalf of, AAA Trailer) would either be capped in a similar manner or would be covered with additional, non-impacted soil as part of one of the landfill regrading alternatives. As part of the Area 1 and 2 Landfill Alternatives, it is expected that the slope of the landfill berm will be reduced through placement of additional clean fill over the top of the landfill berm to reduce the slope angle to below 25 degrees. As part of the regrading of the landfill berm, the toe of the berm would be extended to the north over the Buffer Zone, thereby providing a cover over the radiologically impacted soil.

Alternative F3 would also entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. The land use restrictions described under Alternative F2 would also apply to the Buffer Zone and the Crossroads Property under Alternative F3.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Soil sampling will be undertaken to support the remedial design and confirm these assumptions. Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas in the Buffer Zone. Under this scenario, the use restrictions associated

with the landfill cover alternatives will encompass the Buffer Zone and no additional use restrictions will be necessary to address this property. Land use restrictions may be required for Crossroad Lot 2A2 to prevent exposure to radiologically-impacted soil, if any, that may be present beneath this parcel and to protect the integrity of the landfill toe and cover system on the adjacent Buffer Zone.

Alternative F3 would include additional soil sampling to assess the current conditions of the surface soil in Lot 2A2 and the Buffer Zone after the recent grading and capping activity performed by, or on the behalf of AAA Trailer. Alternative F3 would also include installation of a perimeter fence to control access, institutional controls to control land use, and the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2.4 Alternative F4 – Excavation of Soil with Radioactivity Above UMTRCA Standards

Alternative F4 would entail excavation of the radiologically impacted soil from the Buffer Zone and/or Crossroad property and consolidation of the radiologically impacted soil on the surface of Area 2. Prior to excavation of soil, the existing gravel cover previously constructed by AAA Trailer would need to be removed. All soil containing radium or thorium at levels greater than 5 pCi/g above background would be excavated and placed on top of Area 2. Upon completion of excavation, verification sampling would be performed followed by backfilling and regrading of the area and replacement of the gravel cover.

Based on the results of investigations of the Buffer Zone and Crossroad property conducted prior to 1999, the extent of radiologically impacted soil covered all of the Buffer Zone and the majority of Crossroad Lot 2A2, a total area of approximately 5.4 acres. In 1999, the surface of Crossroad Lot 2A2 and a portion of the Buffer Zone was scraped to a depth of approximately one to two feet and the removed soil was placed in stockpiles on the Buffer Zone. This soil removal was apparently performed by AAA Trailer, as part of their development of a parking area for tractor trailers on the adjacent Lot 2A1. Additional soil sampling and analyses were performed in February 2000 to assess potential occurrences of radionuclides that may remain after the 1999 soil removal. Results of this sampling indicated that with the exception of one sample (RC-02 obtained near the location of boring WL-206 on the Buffer Zone in the area of the former slope failure), all of the samples displayed radionuclide levels that were less than 5 pCi/g above background. Based on these data, the area that still contained radiologically impacted soil with radionuclide levels greater than 5 pCi/g above background was anticipated to be quite small and could possibly have been limited to the Buffer Zone. Based on the available data, the total extent of the area that may still contain radionuclides at levels greater than 5 pCi/g above background at that time (2000) was estimated to be approximately one acre.

The above description represents conditions found to exist in 2000, prior to the most recent regrading of Lot 2A1 and the Buffer Zone. AAA Trailer has reported that the most recent regrading involved pushing soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. Since the current soil conditions do not represent those during the February 2000 soil sampling, the extent of soil containing radionuclides at levels above unrestricted use standards could be greater or less than the one acre area estimated to exist in 2000. As previously indicated, for purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone.

The area to be excavated would be defined based on the results of additional sampling and laboratory analyses. Additional soil sampling and testing would be performed in accordance with the MultiAgency Radiation Survey and Site Investigation Manual (MARRSIM) to determine the extent of the area requiring excavation. Alternatively, a prescribed area and depth of excavation could be defined that would include all of the radiologically impacted soil along with unimpacted soil. For example, the top one-foot of soil could be removed from the entire area of the Buffer Zone and Lot 2A2 of the Crossroad property. Regardless of which technique is used to determine the extent of the area to be excavated, upon removal of the soil, additional confirmation testing will be performed to verify that all of the soil containing radium and thorium at levels greater than 5 pCi/g above background has been removed.

Upon completion of all excavation and verification testing activities, clean fill material would be placed in the excavated area to restore the property to the original grade. If any material is excavated from the Crossroad property, placement of clean fill material would be coordinated with the owner of Lot 2A2 and their development plans for that parcel. Presuming their intent is to place gravel or pavement over this area, the depth of clean fill to be replaced may be adjusted to allow for placement of the gravel surface or pavement. Similarly, placement of clean fill within any portions of the Buffer Zone that may be excavated will need to be coordinated with the anticipated grading plan that may be implemented as part of the landfill area alternatives.

Because Alternative F4 entails removal of all soil containing radium and thorium at levels greater than 5 pCi/g above background and refilling with clean material, no institutional controls or access restrictions are contemplated.

4.5 Screening of Alternatives

Often, prior to the detailed analysis of alternatives, a large number of remedial alternatives are screened in order to screen out certain alternatives, thereby allowing the more detailed evaluation to be undertaken with a reduced number of alternatives. The assembled alternatives are typically screened against the criteria of overall effectiveness in meeting the RAOs, implementability, and cost. The purpose of the screening is to

reduce the number of alternatives that will undergo a more thorough and extensive analysis during the detailed evaluation of alternatives.

Given the limited number of remedial actions that are potentially viable for OU-1 (i.e., six for the landfill area and four for the Buffer Zone/Crossroad property), additional screening to eliminate alternatives was not required. Thus, all of the alternatives have been carried forward to the detailed analysis presented in Section 5.

5 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the remedial alternatives (six landfill alternatives and four Buffer Zone/Crossroad property alternatives) developed in Section 4 are subjected to detailed analysis. The purpose of this detailed analysis is to provide sufficient information to allow for comparisons among the alternatives based on the standard criteria specified in the NCP.

The detailed evaluation of final alternatives for a remedial action is a two-stage process. During the first stage of evaluation, each of the alternatives is assessed against the nine criteria prescribed by the NCP. This first-stage evaluation of the final remedial action alternatives for the OU-1 of the West Lake Landfill is presented in this section. This evaluation is based on the conceptual descriptions of the final alternatives provided in Section 4.4.4.

In the second stage of the evaluation process, the alternatives are compared against each other to identify relative advantages and disadvantages and trade-offs among the alternatives in terms of the nine NCP criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection. The second-stage evaluation of the potential remedial action alternatives for the West Lake Landfill OU-1 is presented in Section 6.

The nine NCP evaluation criteria include:

Threshold Criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria:

- State Acceptance
- Community Acceptance

The NCP [40 CFR Section 300.430(e)(9)(iii)] categorizes these nine criteria into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Each type of criteria has its own weight when it is evaluated. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative,

and include overall protection of human health and the environment and compliance with ARARs (unless a waiver is obtained).

Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The primary balancing criteria represent the main technical criteria upon which the alternative evaluation is based.

Modifying criteria include State acceptance and community acceptance. These criteria may be used to modify aspects of the preferred alternative when preparing the Proposed Plan. Modifying criteria are generally evaluated after public comment on the FS and the Proposed Plan. Accordingly, only the seven threshold and primary balancing criteria are used in the detailed analysis phase. The following sections provide descriptions of the evaluation criteria and the items considered when assessing alternatives with respect to each criterion.

5.1 Description of Evaluation Criteria

Details regarding the specific elements to be considered in the evaluation of the nine NCP criteria are described in this section.

5.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses how each alternative provides and maintains adequate protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment from unacceptable risks posed by contaminants present at the site, in both the short and long term. This criterion is also used to evaluate how risks would be eliminated, reduced, or controlled through the remedial activities. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

5.1.2 Compliance with ARARs

This evaluation criterion is used to evaluate if each alternative would attain federal and State ARARs, or whether invoking waivers to specific ARARs is adequately justified. Other information, such as advisories, criteria, or guidance, is considered where appropriate during the ARARs analysis. The considerations evaluated during the analysis of the ARARs applicable to each alternative are presented below. Potential chemical-, location-, and action-specific ARARs for West Lake Landfill OU-1 were previously identified in Section 3.1.

Chemical-specific ARARs:

- Likelihood that the alternative will achieve compliance with chemical-specific ARARs within a reasonable period of time.
- If it appears that compliance with chemical-specific ARARs will not be achieved, then evaluation of whether a waiver is appropriate.

Location-specific ARARs:

- Determination of whether any location-specific ARARs apply to the alternative.
- Likelihood that the alternative will achieve compliance with the location-specific ARAR.
- Evaluation of whether a waiver is appropriate if the location-specific ARAR cannot be met.

Action-specific ARARs:

- Likelihood that the alternative will achieve compliance with action-specific ARARs.
- Evaluation of whether a waiver is appropriate if the action-specific ARAR cannot be met.

Other criteria and guidance:

- Likelihood that the alternative will achieve compliance with other criteria, such as risk-based criteria.

5.1.3 Long-Term Effectiveness and Permanence

This evaluation criterion addresses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action imposed by the alternative. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met and the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The considerations evaluated during the analysis of each alternative for long-term effectiveness and permanence are presented below. The components addressed for each alternative are described in more detail in the following subsections.

Magnitude of residual risks:

- Identity of remaining risks (risks from treatment residuals) as well as risks from untreated residual contamination.
- Magnitude of the remaining risks.

Adequacy and reliability of controls:

- Likelihood that the technologies will meet required process efficiencies or performance specifications.
- Type and degree of long-term management required.
- Long-term monitoring requirements.
- O&M functions that must be performed.
- Difficulties and uncertainties associated with long-term O&M functions.
- Potential need for technical components replacement.
- Magnitude of threats or risks should the remedial action need replacement.
- Degree of confidence that controls can adequately handle potential problems.
- Uncertainties associated with land disposal of residuals and untreated wastes.

5.1.3.1 Magnitude of Residual Risk

The magnitude of residual risk at the end of remedial activities is measured by numerical standards such as PRGs, or the volume or concentration of contaminants remaining. The characteristics of the residuals remaining are also evaluated, considering their volume, toxicity, and mobility.

5.1.3.2 Adequacy and Reliability of Controls

The adequacy and reliability of controls that are used to either manage treatment residuals or untreated materials that remain after attaining PRGs are evaluated. This criterion includes an assessment of containment systems and institutional controls to evaluate the degree of confidence that they adequately handle potential problems and provide sufficient protection. The criterion also addresses long-term reliability, the need for long-term management and monitoring, and the potential need to replace technical components of the alternative.

5.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

This evaluation criterion addresses the anticipated performance of the treatment technologies employed by each alternative in permanently and significantly reducing toxicity, mobility, and/or volume of contaminants associated with the OU. The NCP

prefers remedial actions where treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The considerations evaluated during the analysis of each alternative for reduction of toxicity, mobility, or volume of contaminants present at a given site are presented below:

Treatment process and remedy:

- Likelihood that the treatment process addresses the principal threat.
- Special requirements for the treatment process.

Relative amount of hazardous material destroyed or treated:

- Portion (mass) of CoPC that is destroyed.
- Portion (mass) of CoPC that is treated.

Reduction in toxicity, mobility, or volume:

- Extent that the total mass of contaminants is reduced.
- Extent that the mobility of contaminants is reduced.
- Extent that the volume of contaminants is reduced.

Irreversibility of treatment:

- Degree that the effects of the treatment are irreversible.

Type and quantity of residuals remaining following treatment:

- Residuals that will remain.
- Quantities and characteristics of the residuals.
- Risk posed by the treatment residuals.

Statutory preference for treatment as a principal element:

- Extent to which the scope of the action covers the principal threats.
- Extent to which the scope of the action reduces the inherent hazards posed by the principal threats at the site.

5.1.5 Short-Term Effectiveness

Short-term effectiveness considers the effect of each remedial alternative on the protection of human health and the environment during the construction and implementation phase. The short-term effectiveness evaluation only addresses protection

prior to meeting the RAOs. The considerations evaluated during the analysis of each alternative for short-term effectiveness are presented below:

Protection of the community during any remedial action:

- Risks to the community that must be addressed.
- How the risks will be addressed and mitigated.
- Remaining risks that cannot be readily controlled.

Protection of workers during remedial actions:

- Risks to the workers that must be addressed.
- How the risks will be addressed and mitigated and the effectiveness and reliability of measures to be taken.
- Remaining risks that cannot be readily controlled.

Environmental impacts of any remedial action:

- Environmental impacts that are expected with the construction and implementation of the alternative.
- Mitigation measures that are available and their reliability to minimize potential impacts.
- Impacts that cannot be avoided, should the alternative be implemented.

Time until RAOs are achieved:

- Time to achieve protection against the threats being addressed.
- Time until any remaining threats are addressed.
- Time until RAOs are achieved.

5.1.6 Implementability

Implementability evaluates the technical feasibility and administrative feasibility (i.e., the ease or difficulty) of implementing each alternative and the availability of required services and materials during its implementation. The following considerations are evaluated during the analysis of each alternative for implementability:

Technical Feasibility

Ability to construct and operate the technology:

- Difficulties associated with the construction.
- Uncertainties associated with the construction.

Reliability of the technology:

- Likelihood that technical problems will lead to schedule delays.

Ease of undertaking additional remedial action:

- Likely future remedial actions that may be anticipated.
- Difficulty implementing additional remedial actions.

Monitoring considerations with respect to effectiveness of the remedy:

- Migration or exposure pathways that cannot be monitored adequately.
- Risks of exposure, should the monitoring be insufficient to detect failure.

Administrative Feasibility

Coordination with other agencies:

- Steps required to coordinate with regulatory agencies to implement any remedy.
- Steps required to establish long-term or future coordination among agencies.
- Ease of obtaining permits for offsite activities, if required.

Availability of Services and Materials

Availability of treatment, storage capacity, and disposal services:

- Availability of adequate treatment, storage capacity, and disposal services.
- Additional capacity that is necessary.
- Whether lack of capacity prevents implementation.
- Additional provisions required to ensure that additional capacity is available.

Availability of necessary equipment and specialists:

- Availability of adequate equipment and specialists.
- Additional equipment or specialists that are required.
- Whether there is a lack of equipment or specialists.
- Additional provisions required to ensure that equipment and specialists are available.

Availability of prospective technologies:

- Whether technologies under consideration are generally available and sufficiently demonstrated.

- Further field applications needed to demonstrate that the technologies may be used full-scale to treat contaminants.
- When technology should be available for full-scale use.
- Whether more than one vendor will be available to provide a competitive bid.

5.1.7 Cost

The estimated costs are presented within the +50/-30 percent accuracy range stated in RI/FS guidance (USEPA, 1988). Capital and O&M costs were prepared using March 2005 dollars. In preparing the capital and O&M cost estimates, a contingency allowance of 25 percent was included to address unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the estimate is prepared. The total contingency allowance is a combination of both scope and bid contingency. Scope contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds. Bid contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial action construction or O&M proceeds.

With respect to the present worth cost analyses, a discount rate of 7 percent (before taxes and after inflation) in accordance with A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, 2000) and a 30-year period of performance for costing purposes were assumed. Additional detail regarding assumptions used in preparing the estimated costs is provided in Appendix D.

In accordance with EPA guidance for conducting RI/FS (EPA, 1988a), a 30 year period of performance was used in the development of the present worth analysis. As wastes will remain onsite beyond 30 years and considering the longevity of radioactive materials, monitoring and maintenance activities will likely be required beyond the 30 year period used for preparation of the cost estimates. The use of a 30 year period for the present worth analysis of the cost of alternatives is not intended to imply or otherwise provide a basis to limit future site maintenance and monitoring activities to a duration of 30 years. The need for and scope of continued monitoring and maintenance both within and beyond 30 years will be subject to ongoing evaluation as part of the Five Year Review process for the Site. Although cost estimates could be prepared for periods greater than 30 years, the estimated annual costs of monitoring and maintenance activities are similar for all of the alternatives and therefore inclusion of costs beyond 30 years would not result in significant differentiate the between the alternatives.

5.1.8 State Acceptance

This criterion involves technical and administrative concerns that the State may communicate in its comments concerning each alternative.

5.1.9 Community Acceptance

The preferred alternative for OU-1 will be presented to the public in a Proposed Plan, which will provide a brief summary of all of the alternatives studied in the detailed analysis of alternatives section of this FS. In accordance with the NCP, the public will have an opportunity to review and comment on the selected remedial alternative presented in the Proposed Plan. The public's comments will be addressed in the responsiveness summary and ROD for OU-1 for the West Lake Landfill.

5.2 Results of the Detailed Analysis of Alternatives - Areas 1 and 2 Landfill Alternatives

The following sections present the detailed analysis of the six Area 1 and 2 Landfill Alternatives using the seven threshold and primary balancing criteria.

5.2.1 Alternative L1: No Action

This section presents the description and detailed analysis of the No Action alternative. Under the No Action alternative, no engineering measures will be implemented to reduce potential exposures or control potential migration from Areas 1 and 2. Similarly, no additional institutional controls beyond those already in place and no additional fencing will be implemented to control land use, access, or potential future exposures to Areas 1 and 2. As the existing institutional controls cannot be removed or modified without the approval of the land owner(s), EPA and MDNR, the existing institutional controls will remain in effect as part of the No Action alternative. As the West Lake Landfill continues to be an active operating landfill and industrial facility that is fenced and for which access is controlled, and it is anticipated that these ongoing uses will continue into the future, it is assumed that the existing fence and access controls will remain in effect for the No Action alternative. No monitoring will be conducted under the No Action alternative to identify or evaluate any potential changes that may occur to conditions at Areas 1 and 2 or to contaminant levels or occurrences. As radiologically-impacted materials and wastes containing other hazardous substances will remain on-site, a Five Year Review will be performed by EPA as part of the implementation of the No Action alternative.

As the No Action alternative does not include any active engineering measures, it is not consistent with the NCP expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. In addition, as no engineering measures will be implemented under this alternative, the No Action alternative is inconsistent with the presumptive remedy approach established by EPA for CERCLA municipal landfill sites. Even so, the No

Action alternative will be evaluated in this FS, as required by the NCP and the presumptive remedy guidance, as it serves as the baseline for comparison of the effectiveness of the other alternatives.

5.2.1.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming the existing institutional controls are maintained, monitored and enforced and the disposal areas are monitored and maintained. Use of these areas for activities such as outdoor storage that would be ancillary to office or other commercial uses that may be conducted in the future on other portions of the landfill are currently not prohibited. Analysis of potential worker exposures associated with possible future use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that future use of Areas 1 and 2 for outdoor storage could pose a risk to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. This analysis was dependent on the assumed frequency and duration that potential future onsite workers would be present in Areas 1 and 2. With increased frequency and duration of exposure, the potential risks would increase. As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations, infiltration into and erosion of these areas poses a potential risk to human health and the environment in the future.

The No Action alternative does not provide for monitoring and enforcement of institutional controls which is necessary for long-term effectiveness. Additionally, this alternative does not provide for monitoring and maintenance of the disposal areas which would also be necessary to assure long-term effectiveness. Lastly, this alternative does not address all the pathways identified by the RAOs. Therefore, the No Action alternative is not considered to be protective of public health and absent appropriate response actions, the site poses an unacceptable risk over the long term.

5.2.1.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The No Action alternative is expected to meet some but not all of these potential chemical-specific ARARs. Overall radon emissions for Areas 1 and 2 were measured one time and found to be 21.8 pCi/m^2s compared to the UMTRCA standard and radon NESHAP of 20 pCi/m^2s. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly

above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

The No-Action alternative is expected to meet all of the location-specific ARARs identified in Section 3.1.2 of this report.

As there are no active engineering measures associated with the No Action alternative, this alternative would not meet the intent of the EPA's presumptive remedy approach of establishing or enhancing containment of the landfill. Use of the presumptive remedy approach presumes that engineering measures will be employed to cover the waste materials according to relevant and appropriate requirements (e.g., Subtitle D landfill cover requirements). As such, the No Action alternative will not meet the action-specific ARARs associated with a landfill cover that are the presumed remedy under the presumptive remedy approach.

5.2.1.3 Long-Term Effectiveness and Permanence

All current and potential future risks would remain under the No Action alternative. Institutional controls would not be monitored or maintained and the disposal areas would not be monitored and maintained under the No Action alternative. Without monitoring and maintenance of the disposal areas and maintenance, monitoring and enforcement of the existing instructional controls, the no action would not be effective in meeting the RAOs. As indicated above, future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. As the surface of Areas 1 and 2 is not currently adequately covered, infiltration into and erosion of these areas poses an overall potential risk to human health and the environment in the future. Therefore, the No Action alternative may not be effective over the long-term.

The existing institutional controls cannot be changed without the agreement of EPA and MDNR; however, by their nature, institutional controls are not considered to be permanent. The No Action alternative does not include any additional engineered measures to increase the level of containment anticipated to be achieved as part of EPA's presumptive remedy approach for CERCLA municipal landfills and therefore is not a permanent alternative and does not provide the same degree of long-term effectiveness as would be achieved by active engineered measures. It contains no provisions to stabilize or maintain the physical integrity of the disposal areas, and there are no provisions to monitor and maintain existing institutional or access controls. Therefore, the No Action alternative is not considered to be effective over the long-term.

5.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.1.5 Short-Term Effectiveness

As there are no active remediation measures included in the No Action alternative, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken under the No Action alternative, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

The RAOs of (1) preventing direct contact with landfill contents and exposure to radiation; (2) minimizing infiltration and any resulting contaminant leaching to groundwater; (3) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and (4) controlling radon and landfill gas emissions from Areas 1 and 2 would not be met by the No Action alternative.

5.2.1.6 Implementability

As no active or passive remedial technologies would be implemented under the No Action alternative, there are no technical implementability concerns or issues associated with the No Action alternative. There are no engineering or administrative impediments to implementation of the No Action alternative for Areas 1 and 2; however, No Action would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills and therefore would not be implementable.

5.2.1.7 Costs

As no active or passive engineering measures or monitoring will be performed, the only costs anticipated to be associated with Alternative L1, the No Action alternative, are costs associated with performance of Five Year Reviews. The estimated present worth cost for performance of Five Year Reviews over a 30-year period is $47,000.

5.2.2 Alternative L2: Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

This section presents the detailed analysis of Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring. Under this alternative, the existing landfill cover would be inspected; repaired as necessary to eliminate low areas, erosional channels, and re-establish vegetation; and subjected to future inspections and maintenance in conjunction with ongoing landfill operations or post-closure care of the West Lake Landfill. Under Alternative L2, the existing institutional controls at the Site would remain in effect and additional institutional controls will be implemented.

Institutional controls would be used to control current and future uses of the landfill area and of Areas 1 and 2 in particular to limit or restrict activities or land uses that could result in potential exposure to waste materials or contaminants in the landfill or that could affect the integrity of the existing/amended landfill cover included as part of Alternative L2. Institutional controls along with fencing would be used to control and restrict access to Areas 1 and 2. Due to the potential presence of landfill gas and radon, Alternative L2 would also include a provision for an additional land use proscriptive deed restriction covenants requiring installation of a foundation venting system or vapor barrier as part of any new construction that may be undertaken at the landfill. An additional land use covenant would also be implemented to prevent use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. Long-term monitoring and enforcement of the institutional controls are also included under this alternative.

As an additional access restriction, additional fencing would be installed along those portions of the boundaries of Areas 1 and 2 that are not currently fenced. Alternative L2 would also include groundwater monitoring and landfill gas monitoring as described in Section 4.4.4.1.2.

5.2.2.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming institutional controls are maintained, monitored and enforced and the disposal areas are monitored and maintained. Although the evaluations performed for the BRA indicated that for the current uses, the Site does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations,

infiltration into and erosion of these areas poses a potential risk to human health and the environment in the future.

Analysis of potential worker exposures associated with possible future use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that future use of Areas 1 and 2 for outdoor storage could pose a risk to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. This analysis was dependent on the assumed frequency and duration that potential future onsite workers would be present in Areas 1 and 2. With increased frequency and duration of exposure, the potential risks would increase.

Implementation of the additional institutional controls, fencing, and inspection and maintenance of the landfill cover would further ensure that no changes in existing land uses or cover conditions occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative L2 would restrict the potential for unacceptable exposure due to landfill cover degradation in Areas 1 and 2 or by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2.

5.2.2.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). Alternative L2 is expected to meet some but not all of these potential chemical-specific ARARs. Overall radon emissions for Areas 1 and 2 were measured one time and found to be 21.8 pCi/m^2s compared to the UMTRCA standard and radon NESHAP of 20 pCi/m^2s. Although individual wells have shown some isolated exceedances of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

Alternative L2 is expected to meet all of the location-specific ARARs identified in Section 3.1.2 of this report.

This alternative includes ongoing monitoring and maintenance of the existing landfill cover, but the existing landfill cover does not meet the landfill closure requirements (e.g., slope, thickness or permeability standards for landfill covers) of current RCRA Subtitle D regulations that were promulgated after closure of those portions of the landfill that contain Areas 1 and 2. As such, Alternative L2 will not meet the action-specific ARARs associated with a landfill cover that are the presumed remedy under the presumptive remedy approach.

5.2.2.3 Long-Term Effectiveness and Permanence

Alternative L2 includes ongoing monitoring and maintenance of the cover to reduce the potential for erosion by wind or water and eliminates ponding and reduces resultant infiltration, thereby increasing the long-term effectiveness and permanence of the remedy. This alternative would rely on existing land use covenants prohibiting residential use and groundwater use, and restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These land use covenants would be amended to prevent use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. An additional land use covenant may need to be imposed to require testing and installation of foundation venting and/or vapor barrier systems as necessary as part of any new occupied structures that may be constructed in the future at the site outside of Areas 1 and 2. Additional fencing would be installed along the margins of Areas 1 and 2 to restrict access to these areas to authorized personnel. Therefore, Alternative L2 is expected to be effective in limiting potential direct exposure to waste materials. Ongoing monitoring and enforcement of the institutional controls and maintenance of the landfill cover will be required to maintain the effectiveness of this alternative.

The existing institutional controls cannot be changed without the agreement of EPA and MDNR and the same requirement would be implemented for the additional/amended institutional controls. Therefore Alternative L2 is considered to be permanent; however, as this alternative relies in part on Institutional Controls to achieve protectiveness, it is not considered to be as effective as other alternatives that employ engineered measures to provide a higher degree of permanence. Alternative L2 does not include engineered measures to increase the level of containment anticipated to be achieved as part of EPA's presumptive remedy approach for CERCLA municipal landfills.

5.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.2.5 Short-Term Effectiveness

Because no active remedial action would be taken under Alternative L2, no significant short-term risks to the community or to workers because of implementing the action would occur. A slight short-term risk to workers might occur during repair of the existing cover and installation of additional fencing along the margins of Areas 1 and 2. Similarly, no environmental impact from construction activities would occur.

The RAO of preventing direct contact with landfill contents and exposure to radiation would be met immediately upon completion of the repairs to the existing landfill cover, amendment to the access and land use covenants, and installation of additional fencing around Areas 1 and 2. Although Alternative L2 would improve conditions at the landfill, the RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would not be completely met by Alternative L2.

5.2.2.6 Implementability

There are no engineering factors that would affect implementation of Alternative L2. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, this alternative is administratively feasible.

Groundwater monitoring is a component of Alternative L2. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel and materials are readily available to implement the cover repairs and maintenance, additional fencing installation, institutional controls, and monitoring components of this alternative.

This alternative would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills, and therefore is not implementable.

5.2.2.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L2 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 890,000
Estimated annual O&M costs:	$ 240,000 to 260,000
Estimated 30-year present worth costs:	$ 3,900,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled

quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.3 Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential

This section presents the detailed analysis of Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential. Alternative L3 would consist of placing a soil cover over Areas 1 and 2. The areas to be covered are estimated to be approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. In order to provide shielding for a groundskeeper working in Areas 1 and 2 (eight hours per day, one day per week for 26 weeks per year) an 18-inch thick soil cover would need to be installed over Areas 1 and 2. In order to provide additional protection for a worker involved in outdoor storage or other activities on areas 1 and 2 (8 hours per day, 5 days per week, 50 weeks per year) a 30-inch thick soil cover would need to be constructed over Areas 1 and 2. The 30-inch thick cover has been assumed for purposes of the evaluations of Alternative L3. Prior to installation of the cover, the areas to be covered would be graded and leveled to provide a suitable surface for placement of the additional soil cover.

Alternative L3 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties.

In addition to installation of a soil cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential. These institutional controls are necessary to insure that residential uses do not occur at the landfill, and that commercial and industrial uses or ancillary uses do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the soil cover to be installed under Alternative L3. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. With the placement of the additional soil cover to address potential gamma exposure, additional fencing of Areas 1 and 2 would not be necessary under this Soil Cover alternative. Groundwater monitoring and landfill gas monitoring as described under Alternative L2 (Section 4.4.4.1.2) would also be included under this alternative.

5.2.3.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming institutional controls are monitored and enforced and the disposal areas are monitored and maintained. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA did not necessarily evaluate all potential pathways or the maximum exposure scenario. The BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses that would be maintained under Alternative L3. Potential future use of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With installation of additional soil cover, Alternative L3 would eliminate the potential for unacceptable exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Therefore, Alternative L3 would be protective of human health.

Construction of a soil cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of 18 to 30 inches of soil would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation and maintenance of a soil cover would also eliminate any potential for windblown dust containing radionuclides or for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment. Although placement of additional soil cover should reduce the potential for infiltration and subsequent leachate generation, this alternative would not be specifically designed to reduce infiltration and therefore may not be completely protective against possible impacts to groundwater.

5.2.3.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The soil cover to be installed under this alternative would meet the potential chemical-specific ARARs. Placement of additional soil cover and associated

vegetative cover would decrease potential leaching and impacts to underlying groundwater. Given that the overall average radon emission measured during the RI only slightly exceeded the radon NESHAP, placement of additional soil cover under this alternative is expected to ensure that the UMTRCA radon standard and radon NESHAP are met. Installation of an 18-inch soil cover in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. The 30-inch soil cover would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated exceedances of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) “A location-specific requirement may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain.” The landfill was previously developed within this portion of the floodplain, and the only action to be taken under this Soil Cover alternative is the construction of an upgraded cover on an existing facility. This alternative does not include any construction, structures, or additional development in the floodplain. Therefore, the federal and state floodplain requirements do not have any effect or impose any additional conditions on this alternative.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s); this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s); this alternative is not expected to impact any farmlands.

While this alternative assumes placement of additional soil cover over the existing landfill surface, the amount of disturbance to the existing waste materials is anticipated to be minimal. As waste materials will not be exposed, or only minimally exposed during construction of this alternative, implementation of this alternative is not anticipated to result in an attractive nuisance with respect to birds. Therefore, this Alternative L3 should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to the landfill area during construction of this alternative.

Several potential action-specific ARARs may need to be considered if the Soil Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Although placement of additional soil cover over the existing landfill grades would be protective of human health, it will not meet the minimum design or slope requirements established by the Missouri solid waste regulations (10 CSR 80-3 and 10 CSR 80-4). Missouri solid waste regulations require a cover consisting of two-feet of compacted clay with a permeability of 1×10^{-5} cm/sec overlain by at least one foot of soil capable of sustaining vegetation. The soil cover anticipated under this alternative may meet the permeability requirement but would not necessarily be designed or constructed to do so (achieving this requirement is the intent of Alternatives L4 and L5 discussed below). As the 30-inch soil cover would be installed over the existing surface grades, portions of Areas 1 and 2 would still possess slopes less than 2%. Existing slopes on Area 1 are greater than 1% and with the filling in of the low areas on Area 2 during construction of the soil cover; the slopes on Area 2 are expected to be at least 1% also. Consequently, although installation of the additional soil cover will meet the intent of promoting drainage and reducing infiltration through the landfill, this alternative would not meet the action-specific ARARs associated with the presumptive remedy for CERCLA municipal landfills.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing landfill material in Areas 1 and 2 prior to placement of the soil cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.3.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current worker in or adjacent to Areas 1 and 2 are expected to be generally within the accepted risk range of 10^{-4} to 10^{-6} used by EPA based on an assumption of continuation of current uses at the Site. Changes in land use could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Placement of additional soil cover would eliminate potential exposures to trespassers or workers outside of Areas 1 and 2 that may otherwise use Areas 1 and 2 for ancillary purposes. Installation of a soil cover would eliminate or reduce potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals. As this alternative would not necessarily be designed to restrict infiltration and prevent leaching to groundwater or subsurface migration of radon and landfill gas, Alternative L3 may not be effective in preventing migration or exposure via all of the identified pathways at the Site.

Permanence of this alternative would be improved with regular cover inspection and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of the existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Additional institutional controls that may be implemented as part of this alternative would be subject to the same condition and therefore are also considered to be permanent.

5.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.3.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during construction of the soil cover over Areas 1 and 2 and any surface drainage diversions, controls, and structures. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices. Cover installation would require construction workers and equipment that would initially disturb the soil; however, as no regrading of waste materials is anticipated under this alternative, potential exposure to radioactively-impacted material during construction is expected to be minimal. Dust control measures would probably be required to limit worker exposure during construction.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during construction of the soil cover under Alternative L3, disturbance of the landfill surface will probably destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction and re-vegetation of the new soil cover over Areas 1 and 2 is completed. The RAOs of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new soil cover over Areas 1 and 2 is completed. As this alternative would not be designed to reduce infiltration, the RAO of minimizing infiltration and any resulting contaminant leaching to groundwater may not be met by this alternative.

5.2.3.6 Implementability

Placing a soil cover over Areas 1 and 2 is technically feasible. Covers are a well-known technology, commonly implemented at most landfill sites. Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the northern and western edges of the existing cover systems on Areas 1 and 2, it may be difficult to design and construct soil covers over some of the steeper slopes along the margin of Area 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone.

With respect to administrative feasibility for the soil cover component of Alternative L3, because Areas 1 and 2 are within a larger area in an existing landfill, design and construction of soil covers for Areas 1 and 2 would probably require coordination with the Closure and Post-Closure Plan final cover requirements for the Bridgeton Sanitary Landfill. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is implementable.

The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is administratively feasible.

Groundwater monitoring is also a component of Alternative L3. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the soil cover, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of offsite soil borrow sources.

As this alternative would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills, it is not implementable.

5.2.3.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L3 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 8,400,000
Estimated annual O&M costs:	$ 20,000 to 200,000
Estimated 30-year present worth costs:	$ 9,800,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.4 Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System

This section presents the detailed analysis of Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System. Alternative L4 would consist of placing additional soil or clean fill material (as defined in the Missouri solid waste regulations [10 CSR 80-2.010(11)]) over Areas 1 and 2 to increase the final grades to achieve minimum slope angles of 2%. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve minimum slopes of 2%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary.

Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas consistent with the MDNR final cover requirements for operating demolition landfills. The final cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. Although not required for a Subtitle D cover, a layer of rock or concrete/asphaltic-concrete rubble would be installed immediately beneath the clay layer to minimize the potential for bio-intrusion and erosion and increase the longevity of the landfill cover. Surface drainage diversions, controls, and structures would also be designed and constructed on the surface of or adjacent to the landfill cover as necessary to route non-impacted, uncontaminated storm water runoff that has not contacted the underlying waste materials off of Areas 1 and 2 onto the adjacent landfill site or into off-site storm water drainage systems.

The cover system under Alternative L4 would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete/asphaltic concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick layer of soil capable of sustaining vegetative growth.

In addition to installation of a new cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L4 (Regrading of Areas 1 and 2 to achieve a 2% minimum slope and Installation of a Subtitle D Cover System). These institutional controls are necessary to insure that residential uses do not occur at the landfill and that commercial and industrial uses or ancillary uses that could result in unacceptable risks do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or

prohibit land uses or activities that could disrupt the integrity of the new landfill cover to be installed under Alternative L4. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. The fencing of Areas 1 and 2 included under Alternative L2 would not be necessary under Alternative L4. Groundwater and landfill gas monitoring described under Alternative L2 would also be included under this alternative.

5.2.4.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community based on an assumption of continuation of current uses at the Site and assuming institutional controls are monitored and enforced. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. Potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With placement of an upgraded landfill cover, Alternative L4 would effectively eliminate or greatly reduce potential exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Placement of an upgraded landfill cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of an upgraded landfill cover would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation of a landfill cover would also eliminate any potential for windblown dust containing radionuclides, for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment, and for infiltration and any leaching to groundwater. Therefore, Alternative L4 would be protective of human health.

5.2.4.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and

others (Table 3-1). The new landfill cover to be installed under this alternative would meet the potential chemical-specific ARARs. Construction of a new landfill cover would decrease potential leaching and impacts to underlying groundwater. The new landfill cover would ensure that the radon NESHAP is met. As previously discussed in Section 5.2.3.2 under Alternative L3, placement of 18-inches soil/clean fill material alone in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. Placement of a new landfill cover (which is anticipated to be at least 60-inches thick) would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive or active modern landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) “A location-specific requirement may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain.”

Although this alternative may include construction or additional development in the floodplain, the requirements of the floodplain ARARs should be met by this or any of the other alternatives as currently envisioned. As the landfill was previously developed within this portion of the floodplain, and the only action to be taken under Alternative L4 (Regrading of Areas 1 and 2 to a 2% minimum slope and Installation of a Subtitle D

Cover System) is construction of an upgraded cover on an existing facility, the federal and State floodplain requirements should be met by this alternative. This ARAR may potentially affect the ability to place additional soil material along a portion of the Area 2 landfill berm necessary to reduce the slope of the landfill berm as this additional soil material would be placed within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or the portion of the 100-year floodplain that is protected by levees. Design and construction of the regraded landfill berm will need to be performed to the extent practical, in a manner that does not diminish the usefulness of the floodplain. This could be achieved by cutting and filling the existing waste materials in a manner that does not increase the volume of waste or soil materials placed within the floodplain. Although placement of additional soil in the Buffer Zone necessary to meet the maximum slope requirements of the Missouri solid waste regulations may result in some limited construction within the floodplain, this activity is expected to meet the requirement of avoidance of any adverse impacts to the floodplain, to the maximum extent possible, as required by these ARARs.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s), this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s), this alternative is not expected to impact any farmlands.

A portion of Area 1 is located within 10,000 ft of the end of the proposed runway expansion at Lambert - St. Louis International Airport (Figure 3-1). Implementation of this alternative through placement of additional soil over the existing landfill surface to achieve the required grades should not result in significant disturbance or exposure of the existing waste materials and therefore is not anticipated to result in an attractive nuisance with respect to birds. Implementation of this alternative by cutting and filling of the waste materials to achieve the required final grades will result in exposure of the existing waste materials. Depending upon the nature and amount of degradation of the wastes (i.e., construction and demolition wastes versus undegraded municipal refuse), the exposed waste materials may attract birds resulting in non-conformance with the provisions of RCRA Subtitle D and the MDNR regulations regarding bird hazards to jet aircraft. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to that portion of Area 1 located within 10,000 ft of the proposed runway expansion if the runway expansion is completed prior to implementation of the remedial alternative for OU-1. Therefore, this alternative should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport.

Several potential action-specific ARARs may need to be considered if the Landfill Regrading/Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations for landfill covers (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Under this alternative, Areas 1 and 2 would be regraded to achieve minimum slopes of 2%. The Missouri Solid Waste Regulations prescribe a 5% minimum slope for final covers installed over operating solid waste and construction and demolition landfills. As previously discussed in Section 4.4.4.1.6, the 5% slope requirement applies to operating or new landfills and was not intended to be applied retroactively to previously closed landfills. Landfilling in the vicinity of Areas 1 and 2 at the West Lake Landfill was completed approximately thirty years ago and therefore this standard is not applicable. Furthermore, the 5% minimum slope requirement was developed to allow for settlement that may occur over a period of 20 to 30 years after placement of waste materials. The portions of the West Lake Landfill containing Areas 1 and 2 were closed approximately 30 years ago and therefore settlement of this material has already occurred. Therefore, this requirement, although potentially relevant, is not considered to be appropriate for OU-1 at the West Lake Landfill. Regrading Areas 1 and 2 to achieve minimum slopes of 2% will meet the intent of the MDNR minimum slope requirements if not the actual prescribed value of 5%. Consequently, regrading Areas 1 and 2 to achieve minimum slopes of 2% along with installation of an upgraded landfill cover meeting the MDNR design standards for final landfill covers will meet the intent of promoting drainage and reducing infiltration through the landfill required by the MDNR regulations. As the same landfill cover will be installed under Alternatives L4 and L5, Alternative L4 will meet the same standard of performance as would be achieved through reconfiguration of the landfill final grade to 5% as envisioned under Alternative L5. Inclusion of corrective action requirements such as cover repair, cover modification, or groundwater containment as a contingency in the event that this alternative does not perform satisfactorily over time would insure consistency with the goal of this ARAR.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing wastes prior to placement of the initial layer of the Subtitle D cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.4.3 Long-Term Effectiveness and Permanence

Alternative L4 would involve placement of additional soil/clean fill material over or regrading of the existing waste materials in Areas 1 and 2 to achieve minimum slopes of 2% followed by placement of an upgraded landfill cover. Construction of an upgraded landfill cover would effectively eliminate the potential pathways by which receptors could potentially be exposed to contaminants present in Areas 1 and 2. Regrading of the landfill and installation of a new landfill cover would eliminate any potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, incidental ingestion of soil containing radionuclides or other chemicals, and infiltration and any leaching to groundwater.

The permanence of this alternative is enhanced through inclusion of a two-foot thick bio-intrusion/erosion protection layer in the cover design which should increase the longevity of this alternative. Permanence of this alternative would also be improved with regular cover inspections and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Moreover, the land use covenants grant EPA, MDNR, and the owners the right to enforce the terms of the restrictions. Additional institutional controls that may be implemented as part of this alternative would be subject to the same conditions and enforcement rights and therefore are also considered to be permanent.

5.2.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.4.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during the placement of additional soil and installation of a Subtitle D landfill cover over Areas 1 and 2. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices.

Although regrading of existing waste material may be a potential alternative to using clean fill, there are drawbacks associated with it. Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Landfill regrading would require construction workers and equipment that would initially disturb the soil and possibly the underlying waste materials. Possible

short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of the remedial action. A stormwater management plan would be required to control runon and runoff during regrading activities. Dust and possibly odor control measures would probably be required to limit worker and public exposure during construction. Although mitigative measures such as those described above may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if regrading of the waste is performed.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during placement of additional soil or regrading of existing materials and installation of a Subtitle D landfill cover under Alternative L4, disturbance of the landfill surface would destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed.

Due to the time it may take to receive and place the additional soil or clean fill material to achieve the minimum grades of 2% and subsequently construct the upgraded landfill cover, this alternative could take several years to complete. Regrading the existing waste materials to achieve minimum slope angles of 2% and maximum slope angles of 25% may be completed in a shorter period of time.

5.2.4.6 Implementability

Placement of additional soil or regrading of existing materials to achieve minimum slopes of 2% followed by construction of an upgraded landfill cover over Areas 1 and 2 is technically feasible. Regrading of existing landfills through placement of additional soil or regrading of existing materials is a common remedial action that has been implemented at other NPL sites. Installation of an upgraded landfill cover to promote

runoff and minimize infiltration is a commonly employed method of remediation at other CERCLA landfill sites. Construction of landfill covers is a well-established technology that is implemented at most landfill sites.

Cutting and filling of the existing waste materials to achieve final grades will require re-compaction of the replaced waste materials in order to minimize the potential for compaction or differential settlement over time that could affect the integrity of the landfill cover. Placement of additional fill material to achieve the final slope requirements and for construction of the landfill cover may result in compaction of the waste materials dependent upon the nature, age and amount of prior degradation of the waste materials. Uniform or differential compaction of the waste materials could necessitate placement of additional soil over all or portions of the area to achieve the required final grades. The potential for uniform or differential compaction can be addressed through several possible mechanisms including the following: (1) performance of plate load tests during the remedial design activities to assess the potential for and possible degree of compaction or differential settlement; (2) management of the placement of soil stockpiles to pre-compact/pre-consolidate the waste materials prior to final grading activities and cover construction; or (3) provision for a stock pile of suitable soil materials to be used to fill in low spots that may occur over time as a result of differential settlement; or (4) a combination of these techniques. These techniques have been employed at other CERCLA municipal landfill sites such as the Tulalip Landfill in Washington, the Lowry Landfill in Colorado, and others. Long-term maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to address the potential for differential settlement or surface erosion of a landfill cover over time. Long-term maintenance including cover inspection and repair is anticipated to be part of this alternative.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the portions of the northern and eastern edges of Area 1 and the northern and western edges of Area 2 (Figure 4-7), it may be difficult to achieve the desired maximum slope grades along the entire margin of Areas 1 and 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone. It may not be feasible to regrade (reduce the slope angle of those portions of the landfill berm with slopes greater than 25% or possibly greater than $33^{1}/_{3}$% to less than 25%) the northern portion of the landfill berm along the western margin of Area 2 using any of the techniques described. The toe of the landfill extends up to the property boundary/fence line in this area thereby eliminating the potential for placement of additional soil or fill material. As access to this area can only be achieved from above, the ability to regrade this portion of the landfill through excavation of the existing waste and soil material will be limited making it more difficult and more expensive but not necessarily impossible. Fortunately, this portion of the landfill berm has never exhibited any sign of or tendency towards slope or erosional failures and therefore, appears to meet the criteria (10 CSR 80-3.017(B)(3) and 10 CSR 80-4.017(B)(3)) of demonstrating stability at slope angles

greater than 25%; however, much of this area contains slope angles greater than $33^{1}/_{3}$% (Figure 4-7) for which there is no provision for demonstration of stability in the Missouri Solid Waste Regulations (10 CSR 80-3.017(C)(3) and 10 CSR 80-4.017(C)(1)). Similar constraints exist for portions of the landfill in Area 1 (Figure 4-7) due to the presence of the landfill access road which is located along the northern toe of the landfill berm in Area 1 and the presence of the property/fence line along the eastern toe of the landfill and the presence of the drainage ditch along St. Charles-Rock Road immediately outside of the fence line.

As Areas 1 and 2 are within a larger area in an existing landfill, landfill regrading and installation of an upgraded landfill cover under Alternative L4 would require coordination with the landfill owner and operator. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is considered administratively implementable. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is also considered to be administratively feasible.

Groundwater monitoring is also a component of Alternative L4. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of clean fill materials and/or offsite soil borrow sources if and when this alternative is implemented.

5.2.4.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L4 are as follows. Detailed cost estimates and a present worth summary are included in Appendix D. Cost estimates for two options to achieve the minimum slope of 2% before the Subtitle D cover is placed are included.

Soil fill option to achieve minimum slope of 2%:

Estimated capital costs:	$ 21,800,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 23,100,000

Cut/fill existing materials option to achieve minimum slope of 2%:

Estimated capital costs:	$ 20,500,000
Estimated annual O&M costs:	$ 15,000 to 200,000

Estimated 30-year present worth costs: $ 21,700,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.5 Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System

Alternative L5 would consist of placing additional soil or other clean fill material (as defined in the MDNR regulations (10 CSR 80-2.010(11)) over Areas 1 and 2 and/or regrading of the existing landfill materials to increase the final slope angles to 5% achieve the minimum grades specified in the MDNR regulations (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)) for landfill covers. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 5%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary.

Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. The final cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. Although not required for a Subtitle D cover, a layer of rock or concrete/asphaltic concrete debris would be installed immediately beneath the clay layer to minimize the potential for bio-intrusion and erosion and increase the longevity of the landfill cover. Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off from Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems.

The cover system under Alternative L5 would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;
- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and
- A one-foot thick layer of soil capable of sustaining vegetative growth.

In addition to installation of a new cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System. These institutional controls are necessary to insure that residential uses do not occur at the landfill and that commercial and industrial uses or ancillary uses that could result in unacceptable risks do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the new landfill cover to be installed under Alternative L5. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. The fencing of Areas 1 and 2 included in Alternative L2 would not be necessary under Alternative L5. Groundwater and landfill gas monitoring described under Alternative L2 would also be included under this alternative.

5.2.5.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community based on an assumption of continuation of current uses at the Site and assuming institutional controls are monitored and enforced. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. Potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With placement of an upgraded landfill cover, Alternative L5 would effectively eliminate or greatly reduce the potential exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Placement of an upgraded landfill cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of an upgraded landfill cover would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation of a landfill cover would also significantly reduce any potential for windblown dust containing radionuclides, for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as

suspended sediment, and for infiltration and any leaching to groundwater. Therefore, Alternative L5 would be protective of human health.

5.2.5.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The new landfill cover to be installed under this alternative would meet the potential chemical-specific ARARs. Construction of a new landfill cover would decrease potential leaching and impacts to underlying groundwater. The new landfill cover would ensure that the radon NESHAP is met. As previously discussed in Section 5.2.3.2 under Alternative L3, placement of 18-inches soil/clean fill material alone in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. Construction of a new landfill cover (which is expected to be at least 60-inches thick) would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive or active modern landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) “A location-specific requirement

may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain."

Although this alternative may include construction or additional development in the floodplain, the requirements of the floodplain ARARs should be met by this or any of the other alternatives as currently envisioned. As the landfill was previously developed within this portion of the floodplain, and the only action to be taken under Alternative L5 (Regrading of Areas 1 and 2 to a 5% minimum slope and Installation of a Subtitle D Cover System) is construction of an upgraded cover on an existing facility, the federal and State floodplain requirements should be met by this alternative. This ARAR may potentially affect the ability to place additional soil material along a portion of the Area 2 landfill berm necessary to reduce the slope of the landfill berm as this additional soil material would be placed within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or the portion of the 100-year floodplain that is protected by levees. Design and construction of the regraded landfill berm will need to be performed to the extent practical, in a manner that does not diminish the usefulness of the floodplain. This could be achieved by cutting and filling the existing waste materials in a manner that does not increase the volume of waste or soil materials placed within the floodplain. Although placement of additional soil in the Buffer Zone necessary to meet the maximum slope requirements of the Missouri solid waste regulations may result in some limited construction within the floodplain, this activity is expected to meet the requirement of avoidance of any adverse impacts to the floodplain, to the maximum extent possible, as required by these ARARs.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s), this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s), this alternative is not expected to impact any farmlands.

A portion of Area 1 is located within 10,000 ft of the end of the proposed runway expansion at Lambert - St. Louis International Airport (Figure 3-1). Implementation of this alternative through placement of additional soil over the existing landfill surface to achieve the required grades should not result in significant disturbance or exposure of the existing waste materials and therefore is not anticipated to result in an attractive nuisance with respect to birds. Implementation of this alternative by cutting and filling of the waste materials to achieve the required final grades will result in exposure of the existing waste materials. Depending upon the nature and amount of degradation of the wastes (i.e., construction and demolition wastes versus undegraded municipal refuse), the

exposed waste materials may attract birds resulting in non-conformance with the provisions of RCRA Subtitle D and the MDNR regulations regarding bird hazards to jet aircraft. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to that portion of Area 1 located within 10,000 ft of the proposed runway expansion if the runway expansion is completed prior to implementation of the remedial alternative for OU-1. Therefore, this alternative should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport.

Several potential action-specific ARARs may need to be considered if the Landfill Regrading/Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations for landfill covers (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Under this alternative, Areas 1 and 2 would be regraded to achieve minimum slopes of 5%. Therefore, regrading Areas 1 and 2 to achieve minimum slopes of 5% will meet the MDNR minimum slope requirements. Consequently, regrading Areas 1 and 2 to achieve minimum slopes of 5% along with installation of an upgraded landfill cover will meet the requirement of promoting drainage and reducing infiltration through the landfill.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing wastes prior to placement of the initial layer of the Subtitle D cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.5.3 Long-Term Effectiveness and Permanence

Alternative L5 would include placement of additional soil/clean fill material over Areas 1 and 2 or regrading of the existing waste materials in Areas 1 and 2 to achieve minimum slopes of 5% followed by placement of an upgraded landfill cover. Construction of an upgraded landfill cover would effectively eliminate the potential pathways by which receptors could potentially be exposed to contaminants present in Areas 1 and 2. Regrading of the landfill and installation of a new landfill cover would effectively

eliminate any potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, incidental ingestion of soil containing radionuclides or other chemicals, and infiltration and any leaching to groundwater.

The permanence of this alternative is enhanced through inclusion of a two-foot thick bio-intrusion/erosion protection layer in the cover design which should increase the longevity of this alternative. Permanence of this alternative would be improved with regular cover inspections and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Moreover, the land use covenants grant EPA, MDNR and the owners the right to enforce the terms of the restrictions. Additional institutional controls that may be implemented as part of this alterative would be subject to the same condition and enforcement rights and therefore are also considered to be permanent.

5.2.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.5.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during the placement of additional soil and installation of a Subtitle D landfill cover over Areas 1 and 2. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices.

Although regrading of existing waste material may be a potential alternative to using clean fill, there are drawbacks associated with it. Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Landfill regrading would require construction workers and equipment that would initially disturb the soil and possibly the underlying waste materials. Possible short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of the remedial action. A stormwater management plan would be required to control runon and runoff during regrading activities. Dust control and possibly odor control measures would probably be required to limit worker

and public exposure during construction. Although mitigative measures such as those described above may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if regrading of the waste is performed.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during placement of additional soil or regrading of existing materials and installation of a Subtitle D landfill cover under Alternative L5, disturbance of the landfill surface would destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed.

Due to the time it may take to receive and place the additional soil or clean fill material to achieve the minimum grades of 5% and subsequently construct the upgraded landfill cover, this alternative could take several years to complete. Regrading the existing waste materials to achieve minimum slope angles of 5% and maximum slope angles of 25% may be completed in a shorter period of time.

5.2.5.6 Implementability

Placement of additional soil or regrading of existing materials to achieve minimum slopes of 5% followed by construction of an upgraded landfill cover over Areas 1 and 2 is technically feasible. Regrading of existing landfills through placement of additional soil or regrading of existing materials is a common remedial action that has been implemented at other NPL sites. Installation of an upgraded landfill cover to promote runoff and minimize infiltration is a commonly employed method of remediation at other CERCLA landfill sites. Construction of landfill covers is a well-established technology that is implemented at most landfill sites.

Cutting and filling of the existing waste materials to achieve final grades will require re-compaction of the replaced waste materials in order to minimize the potential for compaction or differential settlement over time that could affect the integrity of the landfill cover. Placement of additional fill material to achieve the final slope

requirements and for construction of the landfill cover may result in compaction of the waste materials dependent upon the nature, age and amount of prior degradation of the waste materials. Uniform or differential compaction of the waste materials could necessitate placement of additional soil over all or portions of the area to achieve the required final grades. The potential for uniform or differential compaction can be addressed through several possible mechanisms including the following: (1) performance of plate load tests during the remedial design activities to assess the potential for and possible degree of compaction or differential settlement; (2) management of the placement of soil stockpiles to pre-compact/pre-consolidate the waste materials prior to final grading activities and cover construction; or (3) provision for a stock pile of suitable soil materials to be used to fill in low spots that may occur over time as a result of differential settlement; or (4) a combination of these techniques. These techniques have been employed at other CERRCLA municipal landfill sites such as the Tulalip Landfill in Washington, the Lowry Landfill in Colorado, and others. Long-term maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to address the potential for differential settlement or surface erosion of a landfill cover over time. Long-term maintenance including cover inspection and repair is anticipated to be part of this alternative.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the portions of the northern and eastern edges of Area 1 and the northern and western edges of Area 2 (Figure 4-7), it may be difficult to achieve the desired maximum slope grades along the entire margin of Areas 1 and 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone. It may not be feasible to regrade (reduce the slope angle of those portions of the landfill berm with slopes greater than 25% or possibly greater than $33^{1}/_{3}$% to less than 25%) the northern portion of the landfill berm along the western margin of Area 2 using any of the techniques described. The toe of the landfill extends up to the property boundary/fence line in this area thereby eliminating the potential for placement of additional soil or fill material. As access to this area can only be achieved from above, the ability to regrade this portion of the landfill through excavation of the existing waste and soil material will be limited making it more difficult and more expensive but not necessarily impossible. Fortunately, this portion of the landfill berm has never exhibited any sign of, or tendency towards slope or erosional failures and therefore, appears to meet the criteria (10 CSR 80-3.017(B)(3) and 10 CSR 80-4.017(B)(3)) of demonstrating stability at slope angles greater than 25%; however, much of this area contains slope angles greater than $33^{1}/_{3}$% (Figure 4-7) for which there is no provision for demonstration of stability in the Missouri Solid Waste Regulations (10 CSR 80-3.017(C)(3) and 10 CSR 80-4.017(C)(1)). Similar constraints exist for portions of the landfill in Area 1 (Figure 4-7) due to the presence of the landfill access road which is located along the northern toe of the landfill berm in Area 1 and the presence of the property/fence line along the eastern toe of the landfill and the presence of the drainage ditch along St. Charles-Rock Road immediately outside of the fence line.

As Areas 1 and 2 are within a larger area in an existing landfill, landfill regrading and installation of an upgraded landfill cover under Alternative L5 would require coordination with the landfill owner and operator. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is considered theoretically implementable. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is administratively feasible.

Groundwater monitoring is also a component of Alternative L5. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of clean fill materials and/or offsite soil borrow sources if and when this alternative is implemented.

5.2.5.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L5 are as follows. Detailed cost estimates and a present worth summary are included in Appendix D. Cost estimates for two options to achieve the minimum slope of 5% before the Subtitle D cover is placed are included.

Soil fill option to achieve minimum slope of 5%:

Estimated capital costs:	$ 24,600,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 25,800,000

Cut/fill existing materials option to achieve minimum slope of 5%:

Estimated capital costs:	$ 19,900,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 21,100,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years.

Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.6 Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System

This section presents the detailed analysis of Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System. Alternative L6 would consist of excavation of some accessible portion(s) of the landfill material in Area 2 that may contain relatively higher concentrations of radiologically contaminated material. As discussed elsewhere in this report (Section 4.4.3 and Appendix B), the radiologically-impacted materials in OU-1 do not meet the definition of a "hot spot" as that term is defined in EPA's guidance for the presumptive remedy approach for CERCLA Municipal Landfills (EPA, 1993b). However, evaluation of a potential "hot-spot" removal alternative has been included in this FS report to confirm that the presumptive approach to municipal landfills is appropriately applied. In addition to excavation and offsite disposal of waste materials containing relatively higher levels of radionuclides, Alternative L6 would also include regrading of the landfill surface and construction of a new landfill cover that meets the requirements of the Missouri solid waste regulations, long-term inspection and maintenance of the landfill cover, groundwater and methane monitoring, and monitoring and enforcement of the existing and additional institutional controls described under Alternatives L4 and L5.

5.2.6.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, these evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses that would be maintained. Although the evaluations performed for the BRA indicated that for current use the Site does not pose an unacceptable risk to onsite workers or the offsite community, potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA.

Regrading of the landfill and installation of a new landfill cover would effectively eliminate potential exposure in Areas 1 and 2 by future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Excavation of radiologically-impacted material is not required to achieve protection of human health and the environment as installation and maintenance of a landfill cover meets the remedial action objectives and is protective of human health and the environment. Excavation and offsite removal of the radiologically impacted materials in Area 2 that contain higher levels of radioactivity

would increase the level of protection of public health and the environment over that achieved by installation of a new landfill cover alone in the unlikely event that institutional and engineering controls fail. Although excavation and offsite disposal could increase the level of protection, accidental or inadvertent spillage or dispersal of radioactively impacted materials during excavation or transport could result in increased short-term risks to onsite workers or the public.

Maintenance and enforcement of the existing and additional institutional controls as proposed under landfill Alternatives L2 through L5 would assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk of direct contact with the waste materials or site chemicals would occur in the future.

With implementation of the measures described above, Alternative L6 would eliminate or reduce the potential exposure in Areas 1 and 2 to the public and potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Therefore, Alternative L6 would be protective of human health.

5.2.6.2 Compliance with ARARs

As this alternative includes regrading of the landfill surface and installation of a new landfill cover, the ARARs identified for alternatives L4 and L5 would apply to this alternative. Additional ARARs associated with excavation and offsite disposal of waste materials containing higher levels of radionuclides would need to be complied with by this alternative.

Excavation of the waste materials in Area 2 with higher levels of radioactivity should not entail any construction or adverse impact to the floodplain. Several potential action-specific ARARs may need to be considered if selective excavation of material with higher levels of radionuclides were to be selected by EPA.

Transportation of the excavated materials for offsite disposal would have to be performed in compliance with Department of Transportation requirements. Although not a promulgated regulation, offsite disposal of the excavated material would need to comply with EPA's policy for offsite disposal from CERCLA sites. Offsite disposal would also need to comply with specific requirements such as waste profiling established by the selected disposal facility.

5.2.6.3 Long-Term Effectiveness and Permanence

Alternative L6 would involve excavation and offsite disposal of that portion of the radiologically-impacted material in Area 2 with higher levels of radionuclides and/or gamma activity than other portions of Area 2 as well as landfill regrading and installation of a Subtitle D landfill cover. As previously discussed under Alternatives L4 and L5,

regrading of the landfill and installation of a Subtitle D landfill cover would provide effective and permanent containment of the waste materials. Removal of the radiologically-impacted materials with the higher levels of radionuclides or gamma activity would reduce the overall magnitude of the residual radioactivity at the Site thereby providing an additional level of protectiveness in the unlikely event of failure of institutional or engineering controls. As radiologically-impacted materials would still remain on site, excavation of "hot spots" alone is neither effective nor permanent. The long-term effectiveness and permanence would be achieved through implementation of one of the landfill regrading/cover alternatives (L4 or L5) discussed in the previous sections.

5.2.6.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.6.5 Short-Term Effectiveness

Excavation and offsite transport of radiologically-impacted material in Area 2 with higher levels of radionuclides and/or gamma activity would result in short-term impacts and potential risks to onsite workers and the community. Traffic accidents associated with offsite truck and rail transport will result in risk of physical injury and potentially death to members of the public. Implementation of the offsite disposal portion of this alternative is anticipated to require approximately 4,300 truck trips of approximately 10 miles roundtrip each to haul the excavated material to a rail facility and approximately 1,100 train railcar load trips (eleven train trips of 100 cars each) of 1,600 miles each. Based on 2002 accident rates for large trucks of 2.14 fatal accidents and 44 injury accidents per 100 million vehicle miles traveled (National Highway Transportation Safety Administration [NHTSA], 2003), the truck trips are expected to pose a risk of fatality from an accident of 9.2×10^{-4} (approximately a one in one-thousand risk) and a risk of injury from an accident of nearly 2% (1.9×10^{-2}). Based on 2003 accident rates for train traffic of 4 per million train miles exclusive of train-highway accidents and 3.95 per million train miles for train-highway accidents (Federal Railroad Administration [FRA], 2004), transport of excavated waste by train could result in a risk of accident of nearly 28%.

Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Excavation of existing waste materials will undoubtedly result in odor emissions during the period of time that existing wastes may be handled or exposed. Mitigation of odors through engineering means is limited; however, by performing the waste excavation activities during the winter months, the impacts of odor emissions can be minimized.

Workers involved in the excavation activities may be subject to potential short-term risks. Possible short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of remedial action. Workers would be protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices; however, as this alternative entails excavation, handling and transportation of radiologically impacted materials containing higher levels of radioactivity, OSHA work practices and personal protective equipment may not provide adequate protection against exposure to gamma radiation.

Excavation would require construction workers and equipment that would initially disturb the soil and underlying waste materials. Dust control measures would probably be required to limit worker exposure during construction. Segregation of radiologically-impacted soil from solid wastes and construction/demolition debris may result in adverse risks to remediation workers. Screens used to segregate large items and debris from the soil will become fouled with plastic, wood, and other debris that potentially may need to be physically removed by workers. Such activities will require workers to conduct activities in close proximity to the radiologically-impacted materials thereby increasing short-term exposures for workers.

In addition to development and implementation of a worker health and safety plan, a stormwater management plan would be required to control runon and runoff during regrading activities. Dust and odor control measures would also likely be required. Although mitigative measures such as these may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if excavation and offsite disposal of waste is performed as part of the selected remedial action.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during excavation of waste materials under Alternative L6, disturbance of the landfill surface would destroy those portions of the habitats that currently exist on the surface of Area 2, forcing wildlife to migrate to other areas.

The RAOs of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur and minimizing infiltration and any resulting contaminant leaching to groundwater would not be met by excavation and offsite disposal of waste materials containing relatively higher levels of radionuclides without implementation of one of the engineered landfill capping alternatives.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of (1) minimizing infiltration and any resulting contaminant leaching to groundwater; (2) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and (3) controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed. Implementation of a "hot spot" removal alternative does not affect achievement of the RAOs although it likely will reduce the source term and thereby the magnitude of potential exposures to radionuclides, potential future radon emissions, and potential leaching of radionuclide constituents.

Initiation of this alternative would require significant planning and permitting due to the limited number of offsite disposal facilities capable of taking this material. In addition, as discussed above, implementation of this alternative may need to be timed to occur in the winter months to reduce impacts associated with generation of odors during excavation and handling of existing waste materials. Excavation of existing waste materials would also have to occur prior to any landfill regrading or placement of additional cover materials. Based on the size of Area 2, the volumes of materials to be excavated, and experience at other CERCLA sites with excavation and segregation of radiologically impacted materials, it is anticipated that this alternative will take several years to implement followed by several additional years to complete landfill regrading and cover construction.

5.2.6.6 Implementability

Excavation of radiologically-impacted materials with higher levels of radionuclides and/or gamma activity from Area 2 is technically feasible. Segregation of the soil fraction from the waste materials may be technically feasible, but as discussed above could result in increased worker exposures and attendant risks. Disposal of the excavated materials at an offsite facility is considered to be technically feasible; however, only a limited number of offsite disposal facilities exist and some may not be able to handle materials other than soil (i.e., debris).

Personnel, equipment, and materials are readily available to perform the excavation, and load and transport the material. As there is no railroad access at the Site, a suitable location with existing railcar loading facilities will need to be located or possibly constructed. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of an offsite rail-loading facility and the offsite disposal facility to be used if and when this alternative was to be implemented.

Removal of the impacted soil would require excavation of large volumes of the landfill with the attendant odor and health and safety issues and subsequent screening of the refuse to separate out the soil material, a difficult, time- and labor-consuming, and potentially hazardous activity. Screening of trash material would necessitate use of personnel to remove plastic, wood and other material that would otherwise clog or foul the screens. Workers involved in such activities would be exposed to elevated levels of gamma radiation for which practical, effective protection could not be readily and/or effectively implemented. Furthermore, the act of screening would result in mixing of the more highly impacted soil with less impacted and unimpacted soil.

5.2.6.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L6 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D. The most significant cost component of this alternative is the disposal fee at the offsite disposal facility. The cost estimate provided below is based on a 1999 U.S. Army Corps of Engineers contracted disposal fee for another CERCLA site and is probably not indicative of current disposal fees.

The estimated costs for Alternative L6 are considered to be highly uncertain due to the uncertain nature and volume of the radiologically-impacted materials that may be excavated and shipped for offsite disposal, the extremely limited number of offsite disposal facilities capable of accepting the radiologically-impacted materials, and the resultant limited pricing options that exist as a result of the nearly monopolistic conditions associated with the few available disposal facilities.

This alternative also includes regrading of the landfill and installation of a new landfill cover and other components (groundwater and methane gas monitoring and additional institutional controls) as described under Alternatives L4 and L5. Assuming a new landfill cover similar to that described for Alternative L5 using soil fill to achieve a minimum slope of 5% is selected, the total costs of implementing Alternative L6 would be as follows:

Soil fill option to achieve minimum slope of 5%:

Estimated capital costs:	$ 75,000,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 76,000,000

5.3 Results of the Detailed Analysis of Alternatives - Buffer Zone / Crossroad Property (Ford property) Alternatives

The following sections present the detailed analysis of the four alternatives for addressing radiologically impacted soil, if any, that may still be present on the Buffer Zone and

possibly Lot 2A1 of the Crossroad property. The four alternatives for the Buffer Zone and Crossroad property are evaluated using the two threshold and five balancing criteria specified in the NCP.

In November 1999, the vegetation and surface soil were scraped from the Buffer Zone property and a portion of the adjacent Crossroad property to a depth of approximately 2 to 6 inches. These activities were unauthorized and reportedly conducted by AAA Trailer, a neighboring property owner. The removed materials were piled in a berm along the southern boundary of the buffer property, adjacent to the northwestern boundary of the West Lake Landfill. A small amount of removed materials was also placed in a small pile on the Crossroad property. An investigation of radionuclide occurrences beneath this area was performed as part of the RI activities and a supplemental investigation was performed in February 2000 after the soil regrading activities were discovered in November 1999.

A recent inspection of this area indicated that additional soil removal/grading had been performed on the remaining portion of the Crossroad property and the Buffer Zone. AAA Trailer has reported that the most recent regrading activity involved the soil piles created during the previous regrading activity as well as the remaining soil on Lot 2A2 and the Buffer Zone that had not been excavated during the prior regrading being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. This area is currently being used by AAA Trailer for storage of trailers although use of the Buffer Zone, which is owned by Rock Road, for this purpose has not been authorized.

The levels and extent of radionuclides that may remain in the soil in the Buffer Zone and Crossroad property after the most recent soil regrading activities conducted by AAA Trailer are unknown. For purposes of the evaluation of remedial alternatives for this area, it is assumed that radiologically-impacted material is still present in this area. Prior to implementation of any alternative for the Crossroad property or any soil removal alternative for the Buffer Zone, an investigation of the current conditions of these properties would need to be performed to determine the presence and extent of any radiologically-impacted soil that may still remain in this area.

5.3.1 Alternative F1 – No Action

This section presents the detailed analysis of Alternative F1 – No Action. Under this alternative, no engineering measures will be implemented to reduce potential exposures to the radiologically impacted soil in the Buffer Zone and Crossroad property. Similarly, no additional institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to the Buffer Zone or Crossroad property Lot 2A1. No monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions in the Buffer Zone or Crossroad Lot 2A2 or to contaminant levels or occurrences in this area.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. The No Action alternative assumes that these controls will not be maintained or enforced.

5.3.1.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing land uses. The BRA did not evaluate potential risks that may be posed by unrestricted use of these properties. Although access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties, there are no access or land use restrictions that would prevent changes in the use of the Buffer Zone or Crossroad Lot 2A2 in the future. Therefore, Alternative F1 may not be protective of all possible future uses of the Buffer Zone and Crossroad Lot 2A2. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Therefore, the No Action alternative would not be protective of human health. To the extent that the surface grading and gravel placement actions performed by or on the behalf of AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective, or more protective than assumed for purposed of this FS.

5.3.1.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Since the current levels and extent of radionuclides on the Buffer Zone and Crossroad Lot 2A2 after the recent grading and gravel placement activities conducted by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone exceed the UMTRCA standards. However, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Data obtained in February 2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. AAA Trailer has reported that the regrading activities that occurred subsequent to the February 2000 soil sampling event involved soil being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. Because of the nature of this regrading, it is possible that the radionuclide levels in soil on Lot 2A2 may now be above the UMTRCA standards; however, this cannot be confirmed without additional testing.

Therefore, for purposes of this FS, it is assumed that Alternative F1 would not meet the potential chemical-specific ARARs; however this cannot be confirmed without additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F1. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As the No Action alternative does not include any construction, placement of structures or additional development in the floodplain, it would meet the requirements of the federal and State floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, this alternative is not expected to impact any farmlands.

As this alternative is the No Action alternative, no action-specific ARARs have been identified for this alternative.

5.3.1.3 Long-Term Effectiveness and Permanence

All current and potential future risks would remain under the No Action alternative. The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA

(Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk.

To the extent that the most recent surface grading and gravel placement actions reported by AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective. However, this protectiveness would need to be verified by additional sampling and testing. Although results from soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides that currently exist after the most recent regrading reported by AAA Trailer are unknown. In particular, although AAA Trailer has reported that the most recent regrading involved pushing the soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the disposition of the soil is unknown. Therefore, no action with respect to the Crossroad Lot 2A2 is assumed to not be effective.

Some of the soil samples obtained from the Buffer Zone property, which is owned by Rock Road and is considered to be part of the landfill property, contained radionuclides above the levels for unrestricted use. Therefore the No Action alternative may not be protective of unrestricted use for this area. To the extent that the surface grading and gravel placement actions recently reported by AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective for the Buffer Zone; however, this cannot be confirmed without performance of additional sampling.

As evidenced by AAA Trailer's use of the Buffer Zone, the existing institutional and access controls are insufficient and/or are not sufficiently monitored and enforced to prevent unauthorized use of this property. Therefore, the No Action alternative is not considered to be effective in preventing uses that could result in unacceptable exposure to radiologically-impacted soil.

5.3.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.1.5 Short-Term Effectiveness

As there are no active remediation measures included in Alternative F1, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken on the Buffer Zone and Crossroad Lot 2A2 under Alternative F1, no

short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

As the levels of radionuclides in soil on the Buffer Zone and Crossroad Lot 2A2 may pose an unacceptable risk, the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties may not be met by this alternative. As the levels and extent of radionuclides in the surface soil resulting from the most recent regrading activity reported by AAA Trailer are unknown, this alternative may not meet the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials. Due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative.

5.3.1.6 Implementability

As no active or passive remedial technologies would be implemented under Alternative F1, there are no implementability concerns or issues associated with Alternative F1. There are no impediments to implementing Alternative F1.

5.3.1.7 Costs

The only capital cost associated with the No Action alternative is the cost associated with a one-time soil sampling to assess current radionuclide occurrence on Crossroad Lot 2A2 and the Buffer Zone. This cost is estimated to be approximately $160,000. No ongoing operation and maintenance costs are anticipated to be associated with Alternative F1, the No Action alternative for the Buffer Zone and Crossroad Lot 2A2.

5.3.2 Alternative F2 – Institutional and Access Controls

This section presents the detailed analysis of Alternative F2 – Institutional and Access Controls. Alternative F2 would entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. Under this alternative, land use covenants would be implemented to prohibit residential use of the Buffer Zone and Crossroad property. Additional fencing would be installed along the Buffer Zone as an additional access restriction to complete the perimeter fence around the landfill property.

5.3.2.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. The BRA evaluations did not address unrestricted (residential) use of these properties. In addition, due to the recent regrading activities reported by AAA Trailer, the current levels and extent of radionuclides on these properties is uncertain. For purposes of this FS, it has been assumed that unrestricted use of these properties would not be protective and that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would restrict the potential for residential use and the associated potential risks. Therefore, Alternative F2 is protective of human health for the current and projected future uses of these properties.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. Implementation of institutional controls and fencing as proposed under Alternative F2 would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative F2 would limit the potential for unacceptable exposure in the Buffer Zone and Crossroad Lot 2A2 by potential future industrial/commercial workers that may work in these areas. Although AAA Trailer has reported that the recent regrading activity involved soil being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the levels and extent of radionuclides in the soil are unknown. Until results of soil sampling can confirm conditions, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone and Lot 2A2 exceed standards for unrestricted use of these properties. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F2 would be protective of human health.

As Alternative F2 relies on institutional controls and access restrictions to achieve the additional protectiveness, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks.

5.3.2.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Data obtained in February

2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. However, since the current levels and extent of radionuclides in Buffer Zone and Crossroad Lot 2A2 surface soil after the recent grading and gravel placement activities reported by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil may exceed the UMTRCA standards. Specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Therefore, for purposes of this FS, it is assumed that Alternative F2 would not meet the potential chemical-specific ARARs; however, this can only be confirmed through performance of additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F2. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As this alternative does not include any construction, structures or additional development in the floodplain, it would meet the requirements of federal and State floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, this alternative is not expected to impact any farmlands.

As Alternative F2 only entails implementation of institutional controls and fencing, no action-specific ARARs have been identified for this alternative.

5.3.2.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would restrict the potential for residential use and the associated potential risks.

Although soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides that may currently exist after the most recent regrading activity reported by AAA Trailer are unknown. AAA Trailer has reported that the most recent regrading activity involved pushing soil into a pile located in the northeast corner of the Buffer Zone near monitoring well WL-206. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F2 would be protective with respect to Lot 2A2 and the Buffer Zone; however, as this alternative relies solely on implementation, monitoring and enforcement of institutional controls to insure that unacceptable risks (unrestricted use) do not occur, it is not considered to be as effective or permanent as alternatives that utilize engineered measures to insure protectiveness.

Implementation of additional institutional controls and access restrictions would assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. Therefore, Alternative F2 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2. As Alternative F2 relies on institutional controls and access restrictions to achieve the additional protectiveness, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks

5.3.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.2.5 Short-Term Effectiveness

As there are no active remediation measures included in Alternative F2, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken on the Buffer Zone and Crossroad Lot 2A2 other than implementation of institutional controls and access restrictions under Alternative F2, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. As it is presumed that surface soil containing radionuclides may still be present on the Buffer Zone and Crossroad Lot 2A2, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would not be met under Alternative F2. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative as well as any of the other Buffer Zone/Crossroad property alternatives.

5.3.2.6 Implementability

No active remedial technologies would be implemented under Alternative F2, therefore, implementation of institutional controls and installation of additional fencing along the Buffer Zone are the only aspect of this alternative that may pose implementability concerns or issues. The Buffer Zone is currently owned by Rock Road Industries on behalf of the Respondent group, and therefore implementation of institutional controls and access restrictions is considered to be implementable. Implementation of institutional controls and access restrictions for Crossroad Lot 2A2 would require the consent of the current owner of Lot 2A2. Crossroads Lot 2A2 is currently used and is zoned for commercial/industrial uses. Implementation of a land use restriction limiting future use of this property to commercial/industrial uses only would be consistent with the current and anticipated future uses of the property. No discussions have been held with the owner of this property with respect to their willingness to implement land-use restrictions for this property. Therefore the implementability of this alternative with respect to Crossroad Lot 2A2 is unknown.

5.3.2.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F2 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 210,000
Estimated annual O&M costs:	$ 6,000 – 14,000
Estimated 30-year present worth costs:	$ 290,000

5.3.3 Alternative F3 – Capping and Institutional and Access Controls

This section presents the detailed analysis of Alternative F3 – Capping and Institutional and Access Controls. Alternative F3 would entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. In addition to prohibiting land uses that could result in potential exposure to radioactively impacted materials that may still be present beneath the Buffer Zone or Crossroad Lot 2A2, if any, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the cap to be installed in these areas under Alternative L5. Under this alternative, land use covenants would be implemented to prevent residential use of the Buffer Zone and Crossroad property. In conjunction with the institutional controls, a perimeter fence would be installed along the boundary of the Buffer Zone to control access to the landfill property and a cap consisting of a minimum 6-inch thick gravel layer, asphalt or other form of pavement, or another form of surface preparation would be installed over the Buffer Zone and Crossroad property to prevent direct contact with the radiologically impacted soil. Alternative F3 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

It should be noted that during a site inspection conducted in October 2003 in conjunction with the additional groundwater sampling, it was discovered that Crossroad Lot 2A2 and the Buffer Zone had been graded and a gravel cover had been installed. Trailers associated with AAA Trailer's operations were parked in this area. No information has been obtained regarding the nature of the grading work, the disposition of the soil piles created as part of the previous (1999) grading of Lot 2A1 by AAA Trailer, or the nature and thickness of the gravel cover other than AAA Trailer reporting that soil was pushed into a pile located in the northeast corner of the Buffer Zone near monitoring well WL-206. The most recent grading and gravel placement reported by AAA Trailer is similar to what is proposed to be conducted under this alternative. As discussed earlier, for purposes of this FS, it is assumed that soil containing levels of radium and thorium above UMTRA standards are still present in this area. Therefore, the NCP factors such as

implementability and costs have been evaluated under the assumption that the grading and gravel cap installation have yet to be performed.

5.3.3.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. Placement of a cap over Lot 2A2 and the Buffer Zone would provide an engineered barrier to limit potential worker exposures and therefore provide an additional level of protection. The BRA evaluations did not address unrestricted (residential) use of these properties and due to the most recent regrading activities reported by AAA Trailer, the current levels and extent of radionuclide occurrences on these properties is uncertain. Therefore, for purposes of this FS it is assumed that unrestricted use of these properties would not be protective. Implementation, monitoring, and enforcement of institutional controls limiting these properties to commercial industrial uses in conjunction with construction of a cap would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F3 would be protective of human health.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties.

Placement of a gravel, asphalt or other type of cover over the surface of the Buffer Zone and Crossroad Lot 2A2 would further reduce potential risk to workers or the offsite community by eliminating direct contact with or inhalation or inadvertent ingestion of soil containing radionuclides. Implementation of institutional controls and fencing as described under Alternative F2 would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative F3 would further eliminate the potential for unacceptable exposure with respect to the Buffer Zone and Crossroad Lot 2A2 by potential future industrial/commercial workers that may work in these areas. Therefore, Alternative F3 would be protective of human health.

5.3.3.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Data obtained in February 2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. However, the current levels and extent of radionuclides in

surface soil on the Buffer Zone and Crossroad Lot 2A2 after the most recent grading and gravel placement activities reported by AAA Trailer are unknown. It is presumed that levels of radium and thorium in surface soil on the Buffer Zone may currently exceed the UMTRCA standards; however, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Therefore, for purposes of this FS, it is assumed that Alternative F3 would not meet the potential chemical-specific ARARs; however, this can only be confirmed through performance of additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F3. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As construction of a gravel, asphalt or other surface cap would be conducted under Alternative F3, the federal and State floodplain requirements are potentially applicable or relevant and appropriate to this alternative. Regrading and capping of these properties would need to be designed and implemented in a manner that minimizes potential changes or impacts to the floodplain.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 are no longer used as farmland, this alternative is not expected to impact any farmlands.

Alternative F3 entails construction of a gravel, asphalt or other cap over the Buffer Zone and Crossroad Lot 2A2. No specific potential action-specific ARARs that may apply to this alternative were identified.

5.3.3.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Construction of a cap and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would restrict the potential for residential use and the associated potential risks.

Although soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides in surface soil that may currently exist after the most recent regrading reported by AAA Trailer are unknown. Construction of a cap and perimeter fence along the boundary of the Buffer Zone would provide an additional level of protectiveness for site workers and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F3 would be protective with respect to Lot 2A2 and the Buffer Zone; however, as this alternative relies in part on implementation, monitoring and enforcement of institutional controls to insure that unacceptable risks (unrestricted use) do not occur, it is not considered to be as effective or permanent as alternatives that utilized engineered measures to insure protectiveness.

Construction of a gravel, asphalt or other cover over the surface of the Buffer Zone and Crossroad Lot 2A2 would effectively eliminate or greatly reduce potential for dermal contact, inhalation or inadvertent ingestion of soil containing radionuclides on the Buffer Zone or Crossroad Lot 2A2. Implementation of additional institutional controls and access restrictions would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. Therefore, Alternative F3 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2. To the extent that the surface grading and gravel placement actions performed by or on the behalf of AAA Trailer have resulted in removal of the radiologically-impacted soil in this area, this alternative would be even more likely to be effective.

5.3.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.3.5 Short-Term Effectiveness

As the only active remediation measure included in Alternative F3 is construction of a gravel, asphalt or other type of cap, it does not pose any unacceptable short-term risks or other adverse impacts. No short-term risks to the community or to workers from implementation of this action are expected to occur. Similarly, no environmental impact from construction activities are expected to occur.

Installation of a cap and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. Installation of the gravel, asphalt or other type of cap further assures that potential exposures to radiation will not occur. As the surface soil containing radionuclides on the Buffer Zone and Crossroad Lot 2A2 would be covered by a cap, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would be met under Alternative F3. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative or any of the Buffer Zone/Crossroad property alternatives. Installation of a cap over these areas would further insure that these objectives are met.

5.3.3.6 Implementability

Construction of a gravel, asphalt or other cap on the Crossroad Lot 2A2 property would be performed by Crossroad or by AAA Trailer consistent with the construction of the asphalt and gravel surfaces previously constructed over the AAA Trailer and Lot 2A1 properties. As AAA Trailer has already constructed a gravel surface over Lot 2A2 and the Buffer Zone, this alternative is considered to be implementable.

The Buffer Zone is currently owned by Rock Road and therefore construction of a cap and implementation of institutional controls and access restrictions is considered to be implementable. Implementation of institutional controls and access restrictions for Crossroad Lot 2A2 would require the consent of the current owner of Lot 2A2. Crossroads Lot 2A2 is currently used and is zoned for commercial/industrial uses. Implementation of a land use restriction limiting future use of this property to

commercial/industrial uses only would be consistent with the current and anticipated future uses of the property. No discussions have been held with the owner of this property with respect to their willingness to implement land-use restrictions for this property. Therefore the implementability of this alternative with respect to Crossroad Lot 2A2 is unknown.

5.3.3.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F3 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 340,000
Estimated annual O&M costs:	$ 6,000 – 14,000
Estimated 30-year present worth costs:	$ 420,000

5.3.4 Alternative F4 – Soil Excavation and Consolidation in Area 2

This section presents the detailed analysis of Alternative F4 – Soil Excavation and Consolidation in Area 2. Alternative F4 would consist of excavation of the radiologically impacted soil from the Buffer Zone and/or Crossroad property and consolidation of the excavated material on the surface of Area 2. Under this alternative, all of the soil containing total radium or total thorium greater than 5 pCi/g above background would be excavated and placed on top of Area 2. As previously discussed, the presence, if any, and extent of soil containing total radium or total thorium greater than 5 pCi/g above background after implementation of the most recent regrading and capping of this area performed by, or on the behalf of AAA Trailer is unknown. For purposes of this alternative, it is assumed that the extent of soil containing total radium or total thorium greater than 5 pCi/g above background remains the same as was identified during the prior investigations of this area. Prior to implementation of this alternative, additional investigation of this area would need to be performed to determine if any soil containing total radium or total thorium greater than 5 pCi/g above background still remains in this area.

5.3.4.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. The BRA evaluations did not address unrestricted (residential) use of these properties. Also, after the recent regrading activities reported by AAA Trailer, the current levels and

extent of radionuclides on these properties is uncertain. Therefore, for purposes of this FS it is assumed that unrestricted use of these properties would not be protective. Under this alternative, all soil containing radionuclides at levels above standards for unrestricted use would be removed from these properties. Therefore, Alternative F4 would be protective of human health under both current and all possible future uses of these properties.

Excavation of the radiologically-impacted soil on the Buffer Zone and Crossroad Lot 2A2 and consolidation of the excavated soil on the surface of Area 2 would eliminate any potential for unacceptable risk to workers or the offsite community that may exist on the Buffer Zone or Crossroad Lot 2A2 by eliminating direct contact with or inhalation or inadvertent ingestion of soil containing radionuclides. Removal of all soil containing radionuclides at levels of 5 pCi/g above background would meet the UMTRCA standard for unrestricted land use. Therefore, Alternative F4 would be protective of human health.

5.3.4.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). As the current levels and extent of radionuclides in surface soil on the Buffer Zone and Crossroad Lot 2A2 after the recent grading and gravel placement activities reported by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone may exceed the UMTRCA standards. However, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) has not been performed. Under this alternative, all soil containing radionuclides at levels above standards for unrestricted use would be removed from these properties. Therefore, Alternative F4 would meet the potential chemical-specific ARARs.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is

protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F4. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As excavation of radiologically-impacted soil would be conducted under Alternative F4, the federal and State floodplain requirements are potentially applicable or relevant and appropriate to this alternative. Excavation of soil from these properties would need to be designed and implemented in a manner that minimizes potential changes or impacts to the floodplain.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 are no longer used as farmland, this alternative is not expected to impact any farmlands.

Alternative F4 entails excavation of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2. The UMTRCA soil cleanup standards (40 CFR Part 192) are potential action-specific ARARs for this alternative.

5.3.4.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Excavation of soil containing radionuclides at levels above standards for unrestricted use would be effective in eliminating all possible risks.

Excavation of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2 would eliminate any potential for dermal contact, inhalation or inadvertent ingestion of soil containing radionuclides that may exist on the Buffer Zone or Crossroad Lot 2A2. Excavation of all soil containing radionuclides at levels greater than 5 pCi/g above background would meet the UMTRCA standard for unrestricted land use. Therefore, Alternative F4 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2.

5.3.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative F4 includes removal of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2 and implementation of institutional controls and access restrictions for the Buffer Zone and Crossroad Lot 2A2. This alternative would provide a reduction in toxicity, mobility and volume of radiologically-impacted material on the Buffer Zone and Crossroad Lot 2A2. There would be no reduction of toxicity, mobility or volume through treatment of radiologically-impacted soil on these properties because no treatment technologies would be employed by this alternative. Therefore, no treatment residuals would be generated.

5.3.4.5 Short-Term Effectiveness

The surface soil present on the Buffer Zone and Crossroad Lot 2A2 potentially contains only low levels of radionuclides. Transport of soil excavated from these areas will likely be conducted using internal roads. Consequently, Alternative F4 does not pose any unacceptable short-term risks or other adverse impacts. No short-term risks to the community or to workers from implementation of this action are expected to occur. Similarly, no environmental impact from construction activities are expected to occur.

Excavation of soil containing radionuclides at levels above standards for unrestricted uses would eliminate all potential risks. Therefore, this alternative would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. As the surface soil containing radionuclides on the Buffer Zone and Crossroad Lot 2A2 would be removed, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would be met under Alternative F4. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative or any of the Buffer Zone/Crossroad property alternatives. Excavation of the radiologically impacted materials from these properties would further insure that these objectives are met.

5.3.4.6 Implementability

Prior to removal of the remaining radiologically-impacted soil, if any, from this area, AAA Trailer would have to relocate the trailers they are currently storing in this area and the gravel surface recently constructed by AAA Trailer over Lot 2A2 and the Buffer Zone would have to be removed. As the Respondents do not own or exercise any control over the activities conducted on Lot 2A2, implementation of any remedial activities on

this property would be subject to obtaining permission and an access agreement from the current owner and possibly current lessee.

As the Buffer Zone is currently owned by Rock Road Industries on behalf of the Respondent group, excavation of radiologically-impacted soil is considered to be implementable.

5.3.4.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F4 are summarized below. These costs are based on the assumption that the extent of radiologically-impacted soil beneath Lot 2A2 and the Buffer Zone is the same as the extent identified prior to the more recent regrading and capping activities conducted by, or on the behalf of AAA Trailer. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 600,000
Estimated annual O&M costs:	$ 0
Estimated 30-year present worth costs:	$ 600,000

6 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents the comparative analysis for the alternatives that were evaluated in Section 5. The relative performance of each alternative is evaluated against the performance of the other alternatives for each of the threshold and primary balancing criteria. This comparative analysis identifies the advantages and disadvantages of each alternative to assist in the decision-making process leading to the Proposed Plan.

6.1 Threshold Criteria

Two of the nine criteria specified in the NCP relate directly to statutory findings that must ultimately be made in the ROD. These two criteria are (1) overall protection of human health and the environment, and (2) compliance with ARARs. They are classified as threshold criteria, as each alternative must meet these two criteria.

6.1.1 Overall Protection of Human Health and the Environment

This criteria addresses how risks would be eliminated, reduced, or controlled by the remedial alternatives to provide short- and long-term protection of human health and the environment from unacceptable risks posed by contaminants present at the Site.

6.1.1.1 Areas 1 and 2 Landfill Alternatives

Based on the results of the BRA evaluations, conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming the existing institutional controls are monitored and enforced and the disposal areas are monitored and maintained. Uncertainties remain with respect to potential future use of Areas 1 and 2. For example, use of these areas for activities such as outdoor storage that would be ancillary to office or other commercial uses that may be conducted in the future on other portions of the landfill are currently not prohibited. Analysis of potential worker exposures associated with use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that use of Areas 1 and 2 for outdoor storage would pose potential risks to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Therefore, Alternative L1 (No Action) would not be protective of human health. In addition, as the No Action alternative does not include an engineered and maintained landfill cover, it will not protect against ongoing or potential erosion, infiltration, intrusion and other destabilizing mechanisms. Therefore, the No Action alternative is not protective of public health and the environment.

Under Alternatives L2 and L3, the existing institutional controls would be supplemented to prohibit ancillary uses of Areas 1 and 2, effectively limiting the future use of Areas 1 and 2 to private open space. Access to Areas 1 and 2 is already restricted as part of the overall control of access to the entire West Lake Landfill. Construction of additional fencing around Areas 1 and 2 would be performed as part of Alternatives L2 and L3 providing additional access restrictions thereby further limiting exposure to these areas. Construction of additional fencing under Alternatives L2 and L3 would further limit potential future exposure to Areas 1 and 2 by providing a physical barrier to access to these areas.

Implementation of the additional institutional controls would limit future uses to those that would not result in exposure in Areas 1 and 2 at levels that could pose a potential risk at the levels above the generally accepted risk range used by EPA. Maintenance of the existing landfill cover would be performed to protect against, erosion, infiltration, intrusion or other destabilizing influences. Alternatives L2 would rely on implementation, monitoring and enforcement of access restrictions, institutional controls, and cover maintenance to insure protectiveness.
As Alternative L2 would rely on institutional and access controls and monitoring to insure protectiveness, it does not meet the statutory preference for use of engineered measures to achieve protection and is inconsistent with the expectation of an engineered landfill cover included as a basic premise of EPA's presumptive remedy approach for CERCLA municipal landfills; however, Alternative L2 would be protective of human health.

Construction of a 30-inch soil cover under Alternative L3 and regrading of the landfill and placement of a new cover under Alternatives L4, L5, or L6 over Areas 1 and 2 would provide additional physical protection to site workers or potential trespassers from gamma exposure and from potential direct contact with surface soil containing radionuclides. The combination of the engineered controls (landfill cover improvements) under Alternatives L3, L4, L5, and L6, along with the maintenance of the existing and additional land use covenants, results in Alternatives L3, L4, L5, and L6 providing the greatest level of protection of human health relative to potential gamma exposure and direct contact with waste materials. Installation of the cover materials under Alternatives L3, L4, L5, and L6 would also eliminate any potential for windblown dust containing radionuclides or for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment. Installation of the cover materials under Alternatives L3, L4, L5, and L6 would also reduce potential radon emissions and infiltration of precipitation and potential leaching of radiological and non-radiological contaminants into the underlying groundwater. As Alternatives L4, L5, and L6 include a low permeability layer within the landfill cover design, these three alternatives provide a greater level of protection relative to potential radon emissions and any leaching to groundwater.

Excavation of the radiologically-impacted materials that contain levels of radioactivity that are higher than those found in other portions of Area 2 under Alternative L6 would

reduce the overall levels of radionuclides in Area 2, thereby reducing the residual risk that could potentially be posed by the Site in the unlikely event of failure of the institutional and engineering controls. As radiologically-impacted materials would still remain on-site, a new landfill cover would also be installed under Alternative L6.

As discussed above, protection of public health is achieved through installation of the landfill cover. Excavation and offsite disposal of a portion of the radiologically impacted materials in Area 2 containing higher levels of radionuclides or gamma radiation is not required to achieve protection of public health and the environment nor does it reduce the need for or scope of the landfill capping remedy.

6.1.1.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Based on the results of the BRA evaluations, conditions associated with Lot 2A2 and the Buffer Zone (former Ford property) do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated on an assumption of continuation of existing commercial/industrial land uses. The BRA did not evaluate potential risks that may be posed by unrestricted use of these properties. Soil sampling performed during the RI and after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use. As additional grading was subsequently conducted by AAA Trailer, additional sampling would need to be performed to confirm that the UMTRCA standards for unrestricted use of Crossroad Lot 2A2 and/or the Buffer Zone are met. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Therefore, the No Action alternative (Alternative F1) would not be protective of human health.

Under Alternative F2, institutional controls would be implemented to restrict future uses of the former Ford property (the Buffer Zone and Lot 2A2 of the Crossroad property) to commercial and industrial uses. Implementation of institutional controls would effectively eliminate or greatly reduce the unlikely potential that the former Ford property would be used for residential or other land uses that were not considered reasonable in the BRA evaluations. Assuming radionuclides at levels above standards for unrestricted use are still present in soil on these properties and assuming future unrestricted use of these properties, Alternative F2 would not be protective of human health.

Alternative F3 includes capping of the Buffer Zone and Lot 2A2 of the Crossroad property to prevent direct contact with or erosion of any radiologically impacted soil that may still exist along with implementation of institutional and access controls to restrict future uses of the Buffer Zone and Crossroad Lot 2A2. Capping of Lot 2A2 and the Buffer Zone would eliminate exposure to soil containing radionuclides at levels above standards for unrestricted use and would prevent erosion of soil containing radionuclides. Therefore, Alternative F3 would be protective.

Alternative F4 entails excavation of radiologically-impacted soil at levels above the UMTRCA standards thereby allowing for unrestricted future use of the Buffer Zone and Crossroad Lot 2A2. By removing soil containing radionuclides, this alternative would allow for unrestricted use of these properties and therefore is the alternative that is most protective of human health and the environment.

6.1.2 Compliance with ARARs

Compliance with ARARs also serves as a threshold criterion that must be met by any alternative for it to be selected as a remedy, unless an ARARs waiver is obtained. Possible ARARs that may potentially be applicable or relevant and appropriate to OU-1 are summarized on Tables 3-1, 3-2 and 3-3.

6.1.2.1 Areas 1 and 2 Landfill Alternatives

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radium and non-radionuclide constituents (Table 3-1). The No Action (L1) and the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (L2) alternatives are expected to meet some but not all of these potential chemical-specific ARARs. The soil cover alternative (L3) and landfill regrading and cover alternatives (L4, L5, and L6) are expected to meet all of the chemical-specific ARARs.

With the exception of two monitoring wells that slightly exceed the MCL for radium, groundwater beneath the Site currently meets the UMTRCA groundwater protection standards and the Missouri MCLs for radionuclides. A few monitoring wells in the vicinity of Areas 1 and 2 also contain benzene and/or arsenic at levels slightly above the MCLs for these constituents. Occurrences of these constituents are isolated and not representative of a plume or large area of groundwater contamination beneath or downgradient of the landfill. Therefore all six landfill alternatives comply with these chemical-specific ARARs. Occurrences of radium, benzene and arsenic above their respective MCLs would not be addressed by the No Action (L1) or the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (L2) alternatives. To the extent that these occurrences result from infiltration of precipitation and leaching within Areas 1 and 2, implementation of an engineered landfill cover may reduce the levels of radium, benzene and arsenic detected in these few wells. If these occurrences are related to sources other than Areas 1 and 2 or are otherwise not the result of infiltration through Areas 1 and 2, none of the alternatives may result in any change in these occurrences.

Radon emissions from the OU-1 portion of the landfill were obtained as part of the RI and resulted in an average value of 21.8 pCi/m^2s which slightly exceeds the radon NESHAP of 20 pCi/m^2s. Therefore Alternative L1 would not meet this ARAR. Repair and maintenance of the existing landfill cover (Alternative L2), placement of additional soil over the landfill surface under Alternative L3 or the construction of an upgraded landfill cover under Alternatives L4, L5, and L6 are expected to provide sufficient attenuation and reduction of radon emissions to meet this standard. All six landfill alternatives provide protection against ionizing radiation; however, Alternatives L1 and L2 rely solely on institutional controls to achieve this protection whereas Alternatives L3, L4, L5, and L6 rely on engineered measures as well as institutional controls to provide this protection.

As no active engineering measures would be implemented under Alternative L1 (No Action), this alternative should meet all of the location-specific ARARs. With respect to location-specific ARARs for Alternatives L2, L3, L4, L5, and L6, archeological resources, endangered species, or wetlands requirements are not considered applicable or relevant and appropriate at the Site. In addition, impact to wetlands or farmland is not expected at any offsite quarry and/or borrow source(s) that may be used for borrow and/or cover materials for these alternatives. Depending upon the method used to regrade the landfill, implementation of Alternatives L4, L5, or L6 could trigger either the floodplain or the proximity to airport runways location-specific ARARs. If the landfill berm is regraded through placement of additional soil, the additional soil would need to be placed within the 500-year floodplain or the 100-year floodplain that is protected by levees. This will result in a minor modification of the shape of the floodplain in this area. If that portion of Area 1 located within 10,000 ft of the proposed runway expansion of the Lambert - St. Louis International Airport is regraded by cutting and filling of the existing waste materials, exposure of the waste materials could result in attraction of birds necessitating mitigative measures to comply with the proximity to the end of a runway used for turbojet aircraft. With these two exceptions, all six landfill alternatives (L1 through L6) equally address potential location-specific ARARs.

Several potential action-specific ARARs may need to be considered if Alternatives L2, L3, L4, L5, or L6 were to be selected by EPA. Specifically, the Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of cover repair or maintenance (Alternative L2) or clearing/grubbing and any regrading of the existing wastes prior to placement of the initial layers of cover (Alternatives L3, L4, L5, and L6). The Noise Control Act and Noise Pollution and Abatement Act would limit the amount of noise that could occur at the property boundaries during various times of day under Alternatives L2, L3, L4, L5, and L6.

The Missouri Solid Waste Regulations provide specific design criteria for construction of final landfill covers. As the landfill in Areas 1 and 2 was closed in the 1970's before these criteria were promulgated, these criteria are not applicable. They are, however,

potentially relevant and appropriate for any remedial alternatives that entail construction of an upgraded landfill cover over Areas 1 and 2. The Missouri solid waste criteria include design standards for the minimum and maximum slope angles for the final cover as well as the specific design criteria for the thickness and engineering properties of the materials used for construction of the final cover.

As previously discussed, Alternatives L2 and L3 are considered to be protective of human health and the environment, but would not comply with the cover design or slope criteria of the Missouri regulations as neither of these alternatives meet the Subtitle D landfill closure requirement ARARs associated with the presumptive remedy for CERCLA municipal landfills.

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The other landfill regrading/cover alternatives (L4, L5 and L6) are anticipated to meet the cover design and engineering property criteria for construction of a final landfill cover. Alternative L4 entails placement of additional inert fill material or soil or regrading of the existing refuse to achieve a minimum slope angle of 2%, which although not strictly in conformance with the final slope angle criteria of the Missouri solid waste regulations, does meet the intent of the regulations in that this alternative would including regrading of the landfill area to achieve slope angles that are technically sufficient to minimize infiltration by promoting drainage while minimizing erosion potential. Therefore, Alternative L4 (2% slopes) would meet the intent of the MDNR regulations regarding final cover design. Alternative L5 would meet all of the potential landfill cover action-specific ARARs and the 5% slope criteria in the Missouri solid waste regulations. Alternative L6 includes excavation and offsite disposal of Area 2 soil with higher levels of radionuclides followed by regrading to either 2% or 5% slopes and installation of a new landfill cover (similar to alternatives L4 or L5) and therefore would also meet the potential landfill cover action-specific ARARs.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes of the existing cover systems along the northern and eastern boundaries of Area 1 and the northern and western boundaries of Area 2, technically it may be difficult to design and construct covers over the steeper slopes along the margins of Area 2. Due to the proximity of the property boundary with these areas, placement of additional fill material or regrading to achieve slope angles of 25%, or even $33^{1}/_{3}$% or less is also expected to be difficult.

Transportation and offsite disposal of the excavated materials under Alternative L6 would need to be conducted in compliance with Department of Transportation requirements, EPA's CERCLA Offsite Disposal Policy and requirements associated with the disposal site that may be used for this alternative.

6.1.2.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to the former "Ford property" alternatives of OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). The current conditions on the Buffer Zone and Crossroad Lot 2A2 meet the Missouri standards for protection against ionizing radiation. Levels of radium and thorium in surface soil on the Buffer Zone may exceed the UMTRCA standards; however, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area or implementation of MARRSIM statistical-based sampling procedure) has not been performed. As previously discussed, for purposes of completing this FS, it is assumed that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 exceed the UMTRCA standards. Therefore, Alternatives F1 and F2 for the former Ford property would not meet the potential chemical-specific ARARs; however, this cannot be confirmed without the performance of additional testing. Alternative F3 which includes installation of a cover over Lot 2A2 and the Buffer Zone would be protective but may not meet the UMTRA ARAR for cleanup of offsite soil to levels suitable for unrestricted use. Alternative F4 which entails excavation of soil containing radium and thorium at levels above the UMTRA standard and disposal of the excavated soil in Area 2 is the only Ford property alternative that meets the UMTRA standard.

As the Buffer Zone and Crossroad Lot 2A2 are part of an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Lot 2A2 and the Buffer Zone alternatives. These regulations require avoidance, to the maximum extent possible, of any adverse impacts

associated with direct or indirect development of a floodplain. As no active construction is anticipated under Alternatives F1 and F2, these alternatives would meet the federal and State floodplain requirements. As Alternative F3 includes construction of a cap over this area and Alternative F4 includes excavation of radiologically-impacted soil from this area, the federal floodplain requirements are potentially applicable or relevant and appropriate to these alternatives. Similarly, the State floodplain requirements are also potentially applicable or relevant and appropriate to these alternatives. As it is expected that Alternatives F3 and F4 would be implemented without a significant change in surface elevation or grade, these alternatives are expected to comply with the floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, none of the alternatives for these areas are expected to impact any farmlands.

6.2 Primary Balancing Criteria

The alternatives are comparatively analyzed in this section for the next five of the nine criteria, the primary balancing criteria. These five criteria include long-term effectiveness and permanence; reduction of toxicity, mobility and volume through treatment; short-term effectiveness; implementability; and cost. These five criteria are collectively described as the primary balancing criteria as they provide the primary basis for differentiation among the various alternatives.

As Alternatives L1, F1 and F2 were determined to not be protective of public health and the environment and/or did not meet the requirements of the chemical- or action-specific ARARs, these alternatives did not meet the threshold criteria and therefore will not be evaluated or discussed further.

Although it was considered to be protective, Alternative L2 achieves is protectiveness primarily from implementation of existing and additional institutional controls and not from engineering controls. Therefore, this alternative does not meet the CERCLA statutory preference for use of engineering controls. Alternative L2 also did not meet all of the requirements of potential chemical- or action-specific ARARs. Therefore alternative L2 will not be considered further.

Although it was considered to be protective, Alternative L3 did not meet the potential action-specific requirements associated with the CERCLA presumptive remedy for municipal landfills –the cover design and construction requirements associated with MDNR solid waste regulations. Therefore, this alternative does not meet the ARAR requirement for Missouri solid waste management landfills and Alternative L3 will not be considered further.

Consequently, the focus of the comparison of the alternatives in terms of the primary balancing criteria will be on Alternatives L4, L5 and L6 and F3 and F4.

6.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is a measure of the following two principal factors:

- The magnitude of residual risk; and
- The adequacy and reliability of controls.

6.2.1.1 Areas 1 and 2 Landfill Alternatives

As radiologically impacted materials will remain on site under all of the potential remedial alternatives, potential risks associated with the radiologically impacted materials will remain. Construction of a new soil or landfill cover over Areas 1 and 2 under Alternatives L4, L5 and L6 would provide an engineered barrier and therefore should reduce the magnitude of residual risk. Construction of an engineered barrier will also reduce infiltration and provide protection against erosion and intrusion and therefore would reduce the magnitude of residual risk and provide a reliable method to control potential migration of or exposure to hazardous substances present within the waste materials.
Regrading of Areas 1 and 2 through placement of additional clean fill material or soil or by regrading of existing materials and construction of a new landfill cover (Alternatives L4, L5 and L6), would reduce potential exposures and magnitude of residual risk for trespassers or workers outside of Areas 1 and 2 that may otherwise use Areas 1 and 2 for ancillary purposes. Implementation of additional land use covenants restricting the property from being used for outdoor storage or other ancillary uses thereby preventing these potential exposure pathways would provide an additional level of protectiveness. Institutional controls that restrict the types of land use that can be conducted on areas 1 and 2 and at the overall landfill property would also provide protection against possible future disruption of the landfill cover.

Construction of a new landfill cover as envisioned under Alternatives L4, L5, and L6 would eliminate or reduce any potential for exposure from the following potential pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals. Permanence of these alternatives would be improved with cover maintenance and additional institutional controls restricting allowable uses and activities in Areas 1 and 2. Implementation of an engineered landfill cover could reduce the necessity for or degree of reliance on institutional controls and

could allow for a limited number of additional possible future uses (outdoor storage, parking lots, etc.).

Implementation of the "hot spot" removal under Alternative L6, would potentially reduce the overall magnitude of residual risk posed by the radiologically-impacted materials as removal of the radiologically-impacted materials that contain levels of radioactivity that are higher than those found in other portions of Area 2 will reduce the overall levels of radionuclides in Area 2. However, as radiologically-impacted materials would still remain on-site, implementation of Alternative L6 would not lessen the need for or scope of the new landfill cover. As radiologically-impacted materials would still remain, removal of "hot spots" in and of itself does not significantly improve the reliability or degree of control that would be achieved by installation and maintenance of a new landfill cover.

The lower 2% slope to be achieved under Alternative L4 would provide a greater degree of reliability against long-term erosion of the soil cover compared to the 5% slopes included in Alternative L5. In contrast, the 5% slopes of Alternative L5 should provide a greater degree of reliability against possible subsidence and associated increased infiltration that could result from subsidence.

6.2.1.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Depending upon the current conditions (conditions after recent grading and capping activities performed by or on the behalf of AAA Trailer), radiologically-impacted soil may remain beneath the former Ford property. The levels of radionuclides present beneath Lot 2A2 were evaluated during the RI before the recent grading and capping activities by AAA Trailer, and were determined to be below the UMTRCA standards. Based on the BRA evaluations, the levels of radionuclides in the Buffer Zone and Lot 2A2 were calculated to pose potential risks within EPA's accepted risk range. The levels of radionuclides present at the surface beneath the northernmost portion of the Buffer Zone may exceed the UMTRCA standards for surface soil; however, the Buffer Zone is part of the property owned by Rock Road and therefore, under Alternative F3 will be subject to institutional controls on future use. Additional soil cover is proposed to be placed in this area as part of landfill toe regrading under Alternatives L4 and L5 which would eliminate potential exposure to the existing soils and any radionuclides that may remain in this area.

Under Alternative F3, the Buffer Zone and Lot 2A2 would be capped to prevent direct contact with the radiologically impacted materials and to control surface water runoff and erosion and thereby decrease the potential for erosion and subsequent transport of any radiologically impacted materials that may still be present in this area. Therefore, the level of residual risk that may remain if Alternative F3 were selected is minimal. Alternative F4 entails excavation of soil containing radionuclides above the UMTRCA standards from Crossroad Lot 2A2, if any, and the Buffer Zone and therefore would

remove any residual risk that might otherwise be remain in these areas. Excavation of radiologically-impacted soil at levels above the UMTRCA standards under Alternative F4 would allow for unrestricted future use of the Buffer Zone and Crossroad Lot 2A2 and would not rely on institutional controls. Consequently, this alternative is considered to be more reliable than the other Ford property alternatives.

6.2.2 Reduction in Toxicity, Mobility, or Volume through Treatment

This criterion is a measure of the following five principal factors:

- Statutory preference for treatment as a principal element;
- Irreversibility of treatment;
- Type and quantity of treatment residual;
- Amount of hazardous material destroyed or treated; and
- Reduction in toxicity, mobility, or volume.

Due to the overall large volume combined with the overall low activity levels of the radioactively impacted materials, none of the remedial alternatives include any treatment components. As radionuclides are naturally occurring elements, they cannot be neutralized or destroyed by treatment. Treatment technologies such as mixing impacted soil with cement could be used to reduce the mobility of the radionuclides although such treatment would result in an increased volume of radiologically-impacted soil. Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. Containment technologies such as an engineered landfill cover do not address the statutory preference for treatment and are not subject to evaluation under this criterion.

The lack of significant reduction in volume or toxicity of the various landfill and Ford property alternatives is to be expected given the nature of the radiologically impacted materials and is consistent with the presumptive remedy approach for CERCLA municipal landfills. None of the landfill or Ford property alternatives would employ treatment techniques and therefore none of the alternatives would provide any reduction in the volume or toxicity of contaminants beyond the naturally occurring degradation process.

6.2.2.1 Areas 1 and 2 Landfill Alternatives

The potential mobility of the contaminants would be reduced or eliminated through installation of a new landfill cover over Areas 1 and 2 as envisioned under Alternatives L4, L5, and L6 thus eliminating dispersal of radiologically-impacted materials, if any, by infiltration and wind action. Although implementation of Alternative L6 would result in removal of some of the radiologically-impacted materials, this alternative in and of itself is not expected to result in a significant reduction in the mobility of the radionuclides. Excavation of "hot spots" with separation of radiologically impacted soil from municipal solid waste could result in a reduction in the overall volume of impacted materials; however, as discussed below, this option potentially poses additional risks to remediation workers.

6.2.2.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Implementation of the Ford property capping (F3) or soil excavation and consolidation (F4) alternatives would reduce or eliminate the potential for erosion of radiological-impacted soil from this area, if any still remains after the recent activities conducted by AAA Trailer, thereby reducing the mobility of radionuclides from this area.

6.2.3 Short-Term Effectiveness

Short-term effectiveness is a measure of the protection afforded by each alternative during the construction and implementation process. As such, the time until RAOs are achieved is an important component of this criterion. The availability of equipment and specialists to implement the alternative is also a consideration.

This criterion is a measure of the following three principal factors:

- Protection of workers and the community during the remedial action;
- Environmental impacts; and
- Time until remedial response objectives are achieved.

6.2.3.1 Areas 1 and 2 Landfill Alternatives

For Alternatives L4, L5, and L6, the short-term impact on the risks to the community and workers would be minimal during construction of cover systems over Areas 1 and 2 and any surface drainage diversions, controls, and structures. Workers would be adequately protected during construction by adhering to OSHA practices. Cover installation

alternatives (Alternatives L4, L5, and L6) would require construction workers and equipment that would initially disturb the soil. Dust control measures would probably be required to limit worker exposure and potential offsite transport during construction. For Alternatives L4, L5, and L6, the RAOs of preventing direct contact with landfill contents and exposure to radiation; minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions would be met immediately upon completion of construction of the cover systems over Areas 1 and 2.

Excavation of the radiologically-impacted materials from Area 2 that contain higher levels of radionuclides or gamma radiation will result in increased exposures to workers in conjunction with excavation and loading of the radiologically-impacted materials. This alternative would entail excavation, handling, loading and offsite transport of materials with higher levels of radionuclides at the Site and therefore will pose increased risks to onsite workers. The potential for increased exposure and risks is considered to be even higher if screening to separate the soil fraction from the waste materials is included as part of Alternative L6 due to the increased exposure that would occur as a result of the need to clear debris (plastic, wood, etc.) from the screening equipment during the screening process.

Alternative L6 is also expected to result in increased potential exposure and risk to the community during shipment of the excavated materials to the offsite disposal facility. The potential for truck or rail accidents could result in release of and possible exposure to radiologically-impacted soil. The shear numbers of truck and rail trips required to ship the materials will also result in additional physical risk due to potential traffic accidents even if no release of the radiologically-impacted materials occurs as a result of such accidents.

As noted in the BRA, some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during construction of the cover systems under Alternatives L4, L5, and L6, disturbance of the landfill surface will probably destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

Excavation of radiologically-impacted materials from Area 2 that contain higher levels of radionuclides or gamma radiation will increase the time required for regrading and installation of the upgraded landfill cover and for completion of the entire remedial action. Screening of the excavated material is also expected to increase the overall time that would be required for completion of Alternative L6.

6.2.3.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Significant increases in potential exposure or risk to workers or the community is not anticipated to occur as a result of any of the alternatives for the former Ford property. As the former Ford property was previously disturbed by grading activities performed by AAA Trailer in 1999 and 2003, no additional environmental impacts are anticipated for this area.

6.2.4 Implementability

Implementability evaluates the technical and administrative difficulties associated with implementing each alternative.

Personnel, equipment, and materials are readily available to implement the additional fill or regrading, cover repair and maintenance, cover system construction, institutional controls, and monitoring components of Alternatives L4, L5, and L6 and the capping or soil excavation and consolidation components of Alternatives F3 and F4. Personnel, equipment, and materials are also available for implementation of the "hot spot" removal component of Alternative L6; however, only a very limited number of offsite disposal facilities will accept "debris" containing radiologically-impacted materials.

6.2.4.1 Areas 1 and 2 Landfill Alternatives

Implementation of additional institutional controls and construction of additional fencing are administratively feasible, as the owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC.

Groundwater monitoring is a component of Alternatives L4, L5, and L6. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to groundwater monitoring wells located on adjacent properties (Crossroad property and the St. Charles Rock Road right-of-way). Based on the assumed cooperation of property owners, this component of these alternatives is administratively feasible.

The technical feasibility of construction of the cover system component of Alternatives L4, L5, and L6 is similar. Placing soil covers is a well-known technology, commonly implemented at landfill sites. Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes of the existing cover systems along the northern and eastern boundaries of Area 1 and the northern and western boundaries of Area 2, technically it may be difficult to design and construct covers over the steeper slopes along the margins of Area 2. Due to the proximity of the property boundary with these areas, placement of additional fill material

or regrading to achieve slope angles of 25%, or even $33^{1}/_{3}$% or less is also expected to be difficult.

The technical feasibility of the excavation and disposal of radiologically-impacted materials with higher levels of radionuclides and/or gamma activity from Area 2 component of Alternative L6, however, will be significantly more difficult. Extremely challenging technical issues include excavation of large volumes of landfilled materials commingled with the radiologically-impacted materials, addressing the attendant odor concern associated with excavation of landfilled refuse/waste material, segregation/screening of the soil fraction from the waste materials (if necessary with respect to the type of material accepted by the disposal facility), and the construction of an offsite railcar loading facility if an existing loading facility does not exist within a reasonable distance from the site.

With respect to administrative feasibility for the cover system component of Alternatives L4, L5, and L6, because Areas 1 and 2 are within a larger area in an existing landfill, design and construction of separate cover systems for Areas 1 and 2 would require coordination with the existing landfill operator relative to anticipated final grades and closure of adjacent areas of the landfill. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, Alternatives L4, L5, and L6 are considered to be implementable from the administrative perspective. The implementability and potential cost of Alternatives L4, L5, and L6 will also be greatly influenced by the availability and locations of offsite soil borrow sources if and when any of these alternatives are implemented.

6.2.4.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Implementation of institutional controls and installation of additional fencing as an additional access restriction for the Buffer Zone are considered to be administratively feasible as this property is owned and controlled by Rock Road on behalf of the Respondents. Implementation of institutional controls for Crossroad Lot 2A2 would require cooperation and coordination with the current and future owners of this property. Based on prior experience, implementation of institutional controls on Lot 2A2 may be difficult.

Construction of a gravel, asphalt or other cap over Lot 2A2 is considered to be administratively feasible as construction of this type of surface is consistent with the current use of this property. Excavation of radiologically-impacted soil from Lot 2A2 under Alternative F4 would require cooperation of and coordination with the owners of this property and previously was anticipated to be administratively feasible as this activity was anticipated to be consistent with the intended use of this property. With the recent grading and gravel placement in this area and current use for storage of trailers by AAA Trailer, this alternative may not be as easily implemented as Alternative F3.

6.2.5 Cost

For comparison purposes, the estimated total capital cost, estimated annual O&M costs, and estimated 30-year present worth cost estimates are presented in Table 6-1 for each of the alternatives.

6.2.5.1 Areas 1 and 2 Landfill Alternatives

The estimated capital costs for Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System range from $20,500,000 if regrading is achieved through cut and fill of previously placed waste materials to $21,800,000 if regrading is achieved solely through import and placement of additional soil fill. The annual operations and maintenance costs to maintain the cover and conduct groundwater monitoring are between $15,000 and $200,000 per year for either option resulting in estimated 30-year present worth costs for this alternative of $21,700,000 (cut-and-fill of existing materials) to $23,100,000 (additional soil placement).

The estimated capital costs for Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System range from $19,900,000 if regrading is achieved through cut and fill of previously placed waste materials to $24,600,000 if regrading is achieved solely through import and placement of additional soil fill. The annual operations and maintenance costs to maintain the cover and conduct groundwater monitoring are between $15,000 and $200,000 per year for either option resulting in estimated 30-year present worth costs for this alternative of $21,100,000 (cut-and-fill of existing materials) to $25,800,000 (additional soil placement).

The estimated capital cost of the alternative that includes a “hot spot” removal component as well as regrading of Areas 1 and 2 and installation of a Subtitle D cover system (Alternative L6) is approximately $76,000,000. As previously noted, there is a high degree of uncertainty with this estimate due to the uncertain nature and volume of the radiologically-impacted materials that may be excavated and shipped for offsite disposal, the extremely limited number of offsite disposal facilities capable of accepting the radiologically-impacted materials, and the resultant limited pricing options that exist as a result of the nearly monopolistic conditions associated with the few available disposal facilities. Overall, the anticipated costs for “hot spot” removal are significantly greater than those associated with construction of a new landfill cover. Furthermore, adding a “hot spot” removal component will not eliminate the need for, reduce the scope or cost of, or improve the performance of the new landfill cover as the protectiveness of this alternative is derived from installation and maintenance of a new landfill cover not from excavation and offsite disposal of a portion of the radiologically impacted materials.

6.2.5.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

The capital costs for implementation of Ford property Alternatives F3 and F4 are estimated to be $310,000 and $570,000, respectively. Annual operations and maintenance activities are estimated to range from $6,000 to $14,000 per year for Alternative F3. No ongoing O&M costs are expected to occur under Alternative F4. Estimated 30-year present worth values for Alternatives F3, and F4 are $400,000, and $570,000, respectively.

6.3 Modifying Criteria

The final two of the nine criteria are state acceptance and community acceptance. These two criteria are evaluated following comment on the FS report and Proposed Plan and as such are termed modifying criteria.

6.3.1 State Acceptance

This criterion addresses the State's apparent preferences among or concerns about the various alternatives. The State will be provided an opportunity to review and comment on this FS. Upon completion of the FS, EPA will prepare a Proposed Plan describing their evaluation of the statutory requirements for the development and evaluation of alternatives and selection of a remedy for OU-1 and describing their proposed remedy for OU-1. The State will also provided an opportunity to comment on EPA's Proposed Plan. The State acceptance criterion will be evaluated by EPA as part of the final decision-making process during the preparation of the ROD for OU-1.

6.3.2 Community Acceptance

This criterion addresses the community's apparent preferences among or concerns about the various alternatives. Upon completion of the FS, EPA will prepare a Proposed Plan describing their evaluation of the statutory requirements for the development and evaluation of alternatives and selection of a remedy for OU-1 and describing their proposed remedy for OU-1. The Proposed Plan will be issued for public review and comment and a public meeting may be held where verbal comments on the Proposed Plan will be accepted. Individual members or group representatives of the community will also provided an opportunity to provide written comments on EPA's Proposed Plan. The community acceptance criterion will be evaluated by EPA as part of the final decision-making process during the preparation of the ROD for OU-1.

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Tables

Figures